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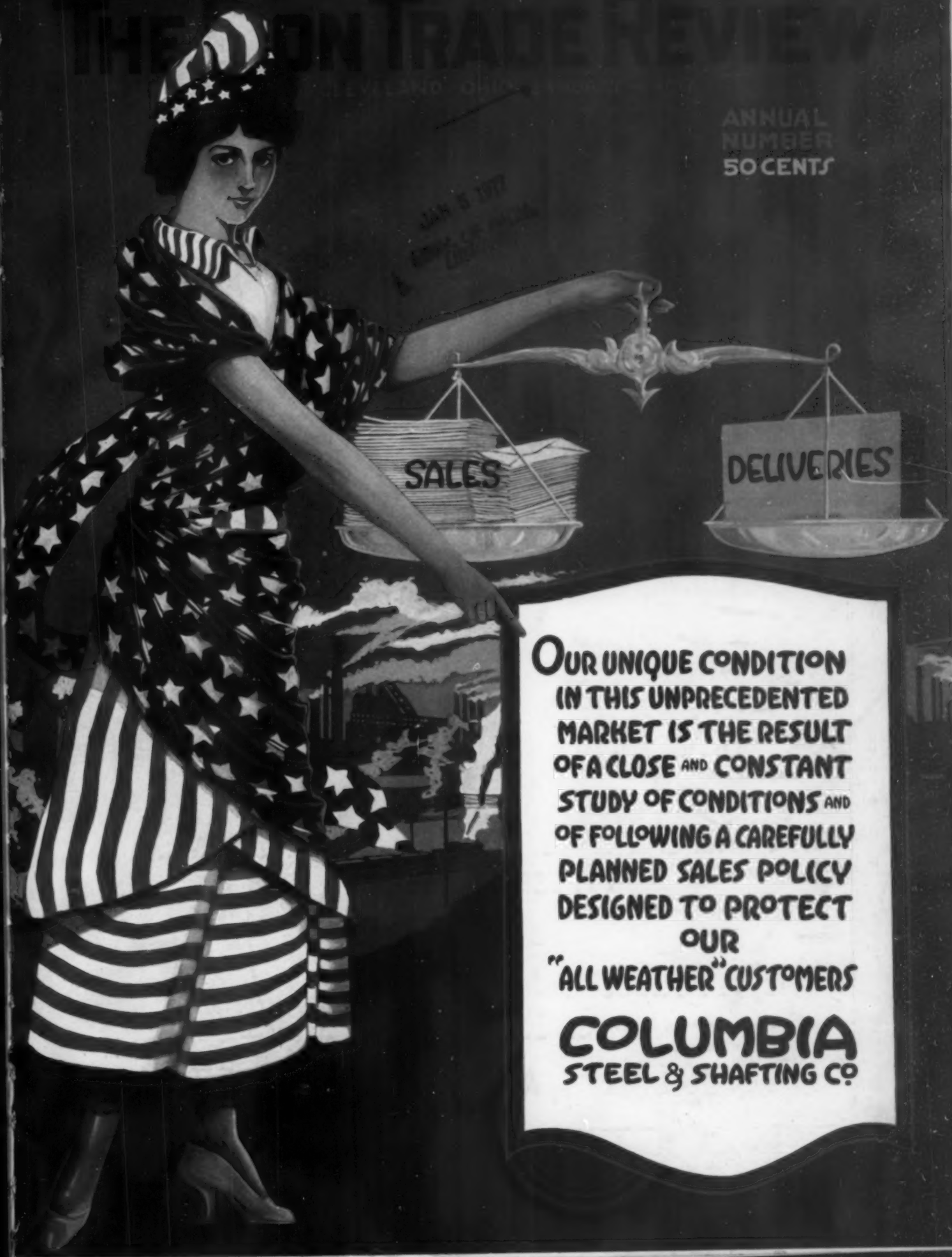


OUR UNIQUE CONDITION IN THIS UNPRECEDENTED MARKET IS THE RESULT OF A CLOSE AND CONSTANT STUDY OF CONDITIONS AND OF FOLLOWING A CAREFULLY PLANNED SALES POLICY DESIGNED TO PROTECT OUR "ALL WEATHER" CUSTOMERS

COLUMBIA
STEEL & SHAFTING CO.

KOPPERS
BY-PRODUCT COKE PLANT

THE DOMINION IRON & STEEL CO., Sidney, Nova Scotia, has awarded to H. KOPPERS COMPANY a contract for a complete by-product coke plant with 120 KOPPERS OVENS to be built at Sidney, Nova Scotia.

H. KOPPERS COMPANY
PITTSBURGH, PA.

Builders of

By-Product Coke Plants
Benzol Recovery Plants
Tar Distilling Plants

Say you saw it in THE IRON TRADE REVIEW

THE IRON TRADE REVIEW

Volume LX Cleveland, Ohio, Jan. 4, 1917 *No. 1*

Broad Americanism, Great Leadership, the Need of the Nation

By George Smart

TWO years ago, in the first issue of *The Iron Trade Review* in 1915, when the great war was only five months old, we quoted from the prophetic speech of William McKinley, delivered at Buffalo, Sept. 5, 1901, the day before he was shot by an anarchist, in which he pleaded for broad Americanism, declared that the period of exclusiveness had passed, urged the trading with other nations in a spirit of fairness, advocated the upbuilding of the merchant marine and emphasized the importance of strengthening the weak places in the industrial and commercial systems of the country.

After asserting our belief that it was time for the people of the United States to wake up and adopt definite, positive measures to develop more fully the resources of their country, as advocated by McKinley, we said that the United States, with profound sympathy for the people of other nations engaged in the most destructive conflict in the history of the world, did not intend to enter upon any sordid policy, but would develop its own strength and thereby increase its usefulness to all the world. We believe that, in a large measure, this statement has proved true. The country has developed its own resources wonderfully, but has not done all that it should do. In some respects, it has failed dismally, especially in not putting the merchant marine on a sound basis, but the country is stronger today and better able to serve the world. It has, indeed, been called upon to take an important part in the Old World's war by furnishing food and munitions to the belligerents who were able to receive such assistance. The response to the call from Europe for a greater volume of supplies than anyone had ever dreamed of came rather slowly and hesitatingly from many manufacturers in this country, for they shrank from the idea of being even remotely connected with the bloody conflict, but it was soon recognized that the exporting would be in harmony with sound international law, as well as with what those who sold for export believed to be the promotion of the cause of righteousness in the world. Hence millions of tons of steel were sold to the allies and millions in gold poured into the United States, but he who says that the steelmakers are sordid and would use their influence to prevent peace being restored does them a monstrous wrong. They sympathize with the feeling of Henry Van Dyke who, thinking of his country in far distant Holland, writes for *The Outlook* the beautiful verses republished on this page by special permission.

These manufacturers, these men of heart and soul, profoundly hope that President Wilson's efforts will hasten the ending of the awful conflict. They yearn for a world peace that will be permanent because founded on justice and would do anything in their power to help establish it. Their prayer is for great leadership—men who see beyond the present and above the little, men who think in terms of continents and worlds, men who are intensely patriotic, but so great in their patriotism that they cannot be unjust to any nation any more than can the great soul who is true to himself be false to any man.

As two years ago *The Iron Trade Review* was dedicated to broad Americanism, we rededicate it now, with a broader, deeper sense of responsibility and ask our readers to help us in adhering to the high ideals of those who are determined to do their part in these wondrous times of opportunity.

America's Prosperity

By HENRY VAN DYKE

They tell me thou art rich, my country: gold
  In glittering flood has poured into thy chest;
  Thy flocks and herds increase, thy barns are pressed
With harvest, and thy stores can hardly hold
Their merchandise: unending trains are rolled
  Along thy network rails of East and West;
  Thy factories and forges never rest;
Thou art enriched in all things bought and sold!

But dost *thou* prosper? Better news I crave.
  O dearest country, is it well with thee
    Indeed, and is thy soul in health?
A nobler people, hearts more wisely brave,
  And thoughts that lift men up and make them free,—
    These are prosperity and vital wealth!

From the Outlook, by special permission.

Where Will War Prosperity Lead Us?

Only the Increase in Steel Production During the Past Two Years Has Been Absorbed by Export Demands—Domestic Needs Are Tremendous—Business Must Be Fortified Against After-the-War Conditions

BY JOHN A. PENTON

IN THE iron and steel industry, there is an almost universal impression that present conditions are inspired by the great European war. And while of course this is largely correct, the present market is not altogether due to the direct consequence of selling large quantities of steel for export; nor is the existing situation entirely the result of the unusually large tonnages that have gone abroad. Rather, it has been brought about by the very abnormal domestic consumption that has come to us by virtue of the great influx of wealth resulting from the call from Europe for equipment and supplies of many different kinds. This demand has quickened the agricultural, industrial and transportation pulse of the entire nation.

When Wheat Spells Steel

The tremendous volume of food stuffs alone that has been exported, increasing from $192,199,252 in the fiscal year ending June 30, 1914, to $657,663,411 in the fiscal year ending June 30, 1916, as shown in the first part of Table II, really spells iron and steel, since the requirements growing out of our manifold agricultural activities, coupled with those involved in moving the crops to market, have, of themselves been sufficient to tax the metal industries of the country to their capacity.

The facts presented in another part of Table II also bear on the situation. This part of the table shows exports of war material, including live stock, chemicals and equipment of a general nature. Iron and steel figures prominently in the production and transportation of practically all of this material. Its exportation in large quantities, therefore, has a direct bearing on iron and steel market conditions in this country. From Table II it will be seen that the difference between exports of war materials in the 12 months ending June 30, 1914, and the 12 months ending June 30, 1916, is $1,400,609,997. In 1915 over 31,000,000 tons of steel ingots were produced in the United States and it has been carefully estimated that at least 39,000,000 tons will be produced in 1916. Present prospects are that even if demand should drop back to a somewhat lesser rate, there still will be at least 43,000,000 or 44,000,000 tons of steel produced in 1917. The industry is now on high gear.

What Export Figures Show

On the other hand, it is quite apparent from government statistics that exports of all grades of steel and steel products in 1916 did not exceed 5,500,000 tons, exclusive of cars, locomotives, automobiles, machine tools, etc. These figures are based upon returns covering exports up to the end of October of last year, shown in Table I. The total exports given in this table, including upwards of 400,000 tons of pig iron, amounted altogether to 4,974,717 tons. The table also gives exports for the first 10 months of 1915 and detailed figures for October, 1915, and the corresponding month in 1916.

THE SYMBOL OF WAR

Is the Prosperity of the Iron and Steel Industry of the United States Necessarily Dependent Upon the Exploding of Shrapnel for its Continuation?

Another Interesting Comparison

Another comparison may be obtained by contrasting iron and steel exports for 1915 with similar exports for the first 10 months of 1916. This comparison shows that the total iron and steel exports for 1915 were 3,533,746 gross tons, while for the first 10 months of 1916 they were 4,974,717 gross tons.

The government, of course, does not compile export statistics relating to locomotives, cars, machinery, etc., on a tonnage basis, but some idea of the volume of this business may be gained from Table III. This table shows the number and value of steam and electric locomotives exported for the fiscal years ending June 30, 1914, 1915 and 1916; it also presents interesting data regarding car exports.

Exports Alone Do Not Rule Prices

The foregoing data lead inevitably to the conclusion that with the most liberal allowances for the tonnage of shells and other munitions requiring steel, less than the increase in production has been absorbed by our foreign steel exports. While our steel production was over 31,000,000 tons in 1915—the largest year in our history up to that time—it actually represented an increase of only 1,000,000 tons over the production of 1913 and 1912. The deduction is clear, therefore, that our domestic requirements have had as much to do with abnormal price conditions as the foreign demand, and also that these domestic requirements were inspired by the prosperity that comes to us by European war conditions.

What Does the Future Hold?

The questions now uppermost in the mind of every civilized human being are, of course, when will the war cease and what of the conditions after the war? It is not part of the policy of *The Iron Trade Review*, under existing circumstances, to engage in any extended discussion of these two subjects. It might be stated, however, that those most competent to pass judgment upon the matter do not, at this time, appear to think that peace is imminent. This means that if this deduction is true, for some time to come the foreign demand for our products of all kinds, including

steel, is likely to be maintained. A most important factor in this connection, and one that generally is lost sight of, is that when Germany took possession of the Belgian iron mines and those in the northern and northeastern part of France, as well as those in Luxemburg, the Central powers of Europe came into control of practically three-fourths of the iron and steel capacity of central Europe. Or, to be more exact, based on the figures of 1913, a producing capacity of almost 30,000,000 tons is held by Germany against less than 2,000,000 tons left available in France and not over 8,000,000 tons in Great Britain.

It is probably true that the Allies have changed this percentage considerably in their favor by the addition of the new blast furnaces and open hearth plants that are known to have been constructed and placed in operation since the war began, but if the war continues, they probably will need as great a volume of steel in the future as in the past from this country.

A serious subject, however, for the consideration of the American producer and consumer of iron and steel is, of course, whether our home consumption will continue to be as large as it has been during the past 12 months, with prices for future delivery on the present basis. Might it not be argued that these prices are going to make consumption very conservative in volume and also check extensive buying into the long distant future?

Will the Market Return to the Normal?

The opinion is very generally held among leaders in the iron and steel industry that the existing situation, with its attendant increase of steel-making capacity, is one that is likely to bring production quickly up to a point where it will more closely approximate shipments, sales and consumption, and that 1917 is likely to see the beginning of a more normal and perhaps a more healthy condition, irrespective of the date of the declaration of peace abroad.

That there is some justification for this is shown from the fact that large additional steel-furnace capacity is building and in prospect of building with the expectation of operating some portion of it during 1917. Since the war began, there has been an average increase of nine open hearth plants a month and judging from the present and contemplated construction, this percentage is likely to be maintained for the year 1917.

It would, therefore, seem reasonable to suppose that this capacity, under the varying circumstances that may exist, will be able to take care of those requirements most urgently needed at home and abroad.

A New Situation Will Exist

As to the "after-the-war" situation in Europe, about which so much has been written, it may be regarded as certain that conditions will be entirely dissimilar to any that have existed before. In the first place, there is now, under the impulse of urgent need, a marvelously altered condition of industry and a new attitude toward efficiency in the allied countries and probably in the countries of central Europe as well.

Extensive manufacturing plants, unknown a year or two ago, have suddenly come into existence,

Table I

Iron and Steel Exports

Gross Tons.

	October,		Ten months ending October,	
	1916.	1915.	1916.	1915.
Scrap	19,994	17,715	178,346	58,098
Pig iron	101,756	21,212	404,260	178,151
Billets, ingots and blooms of steel	162,679	43,429	1,220,788	451,242
Wire rods	13,927	13,647	132,414	135,194
Steel rails	52,753	66,969	444,202	292,265
Steel bars	64,131	40,989	653,330	337,320
Iron bars	4,512	3,384	63,688	29,984
Struc. iron & steel	25,342	23,361	237,211	188,445
Hoops, band and scroll	3,369	3,230	36,621	22,267
Sh'ts & pl'tes	48,923	35,775	419,880	355,819
Tin and terne plate	14,195	17,018	193,318	122,129
Barb wire	37,615	19,910	379,526	192,794
All oth. wire	18,512	16,872	230,519	184,936
Cut nails	541	392	4,204	3,532
Wire nails	13,202	8,143	127,911	74,719
All oth. nails incl. tacks	1,558	1,032	9,282	7,201
Pipes & fit'gs	22,681	10,851	183,847	139,906
R. R. spikes	1,032	2,375	21,172	7,191
Bolts, nuts, rivets and washers	2,919	2,747	24,841	18,333
Horseshoes	222	597	7,251	14,568
Cast radiators	247	195	2,106	1,848
Total	610,110	349,843	4,974,717	2,815,942

Table II

Exports of Foodstuffs and War Materials, 1914-15-16

FOODSTUFFS.	1914.	1915.	1916.
Barley	$ 4,253,129	$ 18,184,079	$ 20,663,533
Corn	7,008,028	39,339,064	30,780,887
Oats	757,527	57,469,964	47,993,096
Rye	1,555,012	14,733,409	15,374,499
Wheat	87,953,456	333,552,226	215,532,681
Wheat flour	54,454,175	94,869,343	87,347,805
Cattle	645,288	702,847	2,383,765
Hogs	133,751	93,067	238,718
Canned beef	461,901	11,973,530	9,353,450
Fresh beef	788,793	21,731,633	28,886,115
Bacon	25,879,056	47,326,129	78,615,616
Pork	852,003	1,219,729	9,338,994
Cheese	414,124	8,463,174	7,430,089
Condensed milk	1,341,140	3,066,642	12,404,384
Sugar	1,839,983	25,615,016	79,390,147
Beans and peas	875,493	3,638,526	5,914,198
Potatoes	1,463,514	2,345,731	3,485,740
Canned vegetables	1,520,879	1,898,840	2,529,694
Total foodstuffs	$ 192,199,252	$ 756,222,953	$ 657,663,411

WAR MATERIAL	1914.	1915.	1916.
Horses	$ 3,388,819	$ 64,046,534	$ 73,531,146
Mules	590,974	12,726,143	22,946,312
Brass manufactures	7,472,476	20,544,559	164,876,044
Aeroplanes	226,149	1,541,446	7,002,005
Automobiles	33,198,806	68,107,818	120,000,866

WAR MATERIAL, CONTINUED	1914.	1915.	1916.
Motorcycles	1,234,194	1,494,176	3,369,616
Freight cars	5,390,705	1,198,806	23,298,823
Chemicals	27,079,092	46,380,986	124,362,167
Cartridges	3,521,533	17,714,205	37,083,488
Dynamite	1,587,184	924,079	3,893,675
Gunpowder	247,200	5,091,542	173,736,374
Other explosives	916,280	17,746,362	252,368,391
Cotton manufactures	51,467,233	71,974,497	112,053,127
Rubber shoes	1,113,495	2,780,325	2,665,362
Tires	4,068,639	5,539,872	20,939,304
Steel bars	7,392,163	10,829,699	37,693,359
Billets	1,042,854	4,815,233	42,421,064
Firearms	3,442,297	9,474,947	18,065,485
Horseshoes	98,835	2,001,258	2,735,079
Gas engines	6,738,793	4,339,316	11,888,531
Steam engines	5,208,424	2,710,782	13,499,320
Metal working mach.	14,011,359	28,162,928	61,315,032
Wire	9,634,614	17,268,807	48,302,317
Lead pigs	1,511,800	7,926,604	11,304,994
Sole leather	7,475,843	21,351,434	27,186,761
Uppers	22,890,388	34,926,063	36,272,847
Men's shoes	10,117,965	17,679,931	36,869,966
Harness	2,667,678	30,563,233	19,174,081
Wool manufactures	4,790,087	27,327,451	53,983,655
Naphtha	5,653,210	10,296,928	29,472,233
Alcohol	67,728	108,985	8,784,742
Zinc	406,208	21,243,935	45,867,156
Totals	$ 244,753,025	$ 588,838,924	$1,645,363,022

employing millions of men and women. They are especially designed, and are equipped in a large measure with the very latest automatic, modern, high-grade machinery. It is known that some of them, from the time their construction was first contemplated, were designed with the purpose of being used after the war for the manufacture of automobile parts, sewing machines, agricultural implements, cars, locomotives and other products for peaceful business at home and abroad.

Furthermore, there has been a vast increase in ship building capacity, capable of turning out every class of craft that floats in large quantities.

Must Compete With Cheap Labor

In addition, hundreds, thousands, even millions of men and women now employed in the construction of war material are going to be available for the industrial work of the peace period. With the low wages that are and probably will be paid in comparison to those paid in the United States (France at the present time is paying both men and women an average of 10 francs per day, or about $1.70 American money, for work of this character per day of 10 hours) our European friends, in all probability, are going to be able to secure a large measure of the world's business.

Also all authorities appear to agree that the governments of the various countries engaged in the war will in all likelihood take a very firm and much advanced position with reference to labor conditions in order to prevent unnecessary disturbances, while at the same time, there is certain to be a large measure of governmental co-operation and encouragement in efforts to control both home and foreign markets. It is believed that the various governments will set aside every precedent in a united effort to aid the citizens of their respective countries to command a good share of the world's business.

This brings us to the thought that if the economic conference of the Allies, and of the Central Powers as well, should resolve to put heavy duties upon large importations of every kind of produce and material that cannot be secured from their respective allied countries, a new factor is going to be introduced into our international relations.

Tariff for Self-Preservation

If, for instance, the Allies, inspired by the need of conserving their gold resources, and co-operating in the effort to pay off the vast debts incurred by the war, should place a tariff of 10, 15, 20 or 25 cents per bushel on all wheat imported except from countries of the Allies; a tariff of 5 or 10 cents per pound upon all cotton imported except from countries of the Allies; a tariff of 25, 50 or 75 per cent *ad valorem* upon automobiles, agricultural implements, railroad equipment or any other kind of machinery imported except from countries of the Allies, and such other import and export duties as might enable them to divide their trade among themselves and facilitate the payment of their common debts, a new situation will arise which will require new policies and new practices throughout the entire world.

If, in addition to the foregoing, a regulation should be adopted by the allied nations, placing a preferential tax or duty of say 5 per cent *ad valorem* on all imports coming into the allied countries by water in ships other than those owned in the allied countries, further far-reaching effects could be looked for. This suggestion is all the more significant in view of the ability of the aforesaid countries to direct and control the operation of their respective merchant marines in times of peace as they have in time of war, thus placing a further handicap and embargo of a most serious character upon foreign trade.

That after peace is made none of the European countries will purchase one dollar's worth more of material, especially iron and steel, from foreign countries than is absolutely necessary is, of course, self-evident.

Europe's After-War Policy

It has been generally reported that a large amount of material, especially iron and steel, will be needed for reconstruction purposes after the war. This is more or less a fallacy because of the determination of the people abroad to fulfill their own requirements, keep their money at home and install the same plan that was followed by the United States after the Civil war in the imposition of tariffs, perhaps of a more prohibitive character than anything we ever dreamed of. This will be done, not in a spirit of bitterness or retaliation, but solely for self-protection, and no people or no individual, especially in the United States, could question the propriety of this policy in view of the tariffs that we ourselves have maintained for so many years.

Table III

Exports of Locomotives and Cars

Fiscal Years Ending June 30, 1914-15-16.

Article	1914 No.	1914 Value	1915 No.	1915 Value	1916 No.	1916 Value
Steam locomotives	383	$3,692,225	228	$2,115,866	799	$12,665,877
Electric locomotives	48	437,452	43	324,478	64	454,544
Steam Passenger cars	...	2,018,853	...	509,024	...	820,713
All other cars	...	5,390,705	...	1,198,806	...	23,298,823

Relief Must Come From Washington

If the war should come to a close at an earlier period than has been universally anticipated, this country of course will have its own domestic markets left. That they are exceptionally large, everyone knows. But when it comes to foreign trade, with our known lack of efficiency and knowledge, our unfamiliarity with the machinery of foreign commerce, our lack of a merchant marine (which will be the worst stumbling block of all) and our extremely high costs of production, the United States will be placed at a disadvantage of a most serious character.

There is only one direction in which the American business man can turn for assistance or aid, and that is to the seat of our national government. Unfortunately there are few business men in America who feel that from such a source will come much that would be of substantial benefit.

This all means, therefore, that American manufacturers in every line must become close students of every phase of the situation. They should take steps to simplify their processes, reduce their costs, and adopt the methods of foreign trade and foreign credits, which those who are familiar with conditions as they exist, fully realize would be necessary to meet an extremely radical situation.

Knocking Out a Billion Dollar Loss

A Solution of the Labor Problem Would Add a Billion Dollars a Year to the National Income—Employers Should Combine on a Definite Program

BY H. COLE ESTEP

BEFORE you settle down to read this article it would be a good idea for you to climb out of your comfortable office chair and take a walk through your shop. Although this suggestion is contrary to all journalistic precedents, it is made advisedly. The usual purpose of the introduction to an article, we are unequivocally informed by numerous "How to" booklets is to "attract the reader's attention". This being true, there is no doubt that in this particular case a thoughtful trip through your plant would be far more effective than the most brilliant introduction that could be penned. For this article purposes to deal with the labor problem—that great, ominous perplexity, which, Vesuvius-like, threatens the vine-clad slopes of business prosperity. Now a great deal of our difficulty with the labor situation arises from our point of view; from the habit of thinking of labor abstractly and in the mass. It is for the purpose of suggesting a satisfactory viewpoint that we have recommended a walk through the shop. After such a trip you will readily perceive that the labor problem is in reality a question of individuals—a *man problem*. Treat this question, with its Vesuvian tendencies, from an ordinary flesh-and-blood, human standpoint, just as you consider matters affecting yourself, and most of its volcanic rumblings will die away. The labor problem is a million problems rolled into one, like a huge snowball; and as each individual is thawed-out the snowball melts away. Make the individual workmen in your institution contented and you will have no more labor troubles.

Can this be done? Most certainly. By firmness, not force; by example rather than by preaching; and by patience coupled with a generous conception of the true aims of business. Furthermore, the time to grapple with the problem is now. The events of 1916 in the labor world and the present situation point clearly to the one fact that next year may be too late. Two and a half years of world war have created new conditions that must be faced resolutely. For the first time in the history of the country, tremendous business expansion has been accompanied by an almost total cessation of immigration. The demand for labor has multiplied like dandelions in the spring, but the usual source of labor—aptly termed "our most necessary raw material"—has been summarily cut off. The result is an unprecedented situation.

The facts regarding business expansion and the stoppage of immigration are patent enough. As far as the former are concerned, this issue

AMERICAN MILL AND FACTORY LABOR IN THE ROUGH

Immigrants from Southern and Southeastern Europe Arriving on a Transatlantic Liner Prior to the War—This Source of Labor Has Been Cut Off for Over Two Years—Now We are Face to Face with the Greatest Labor Shortage in the History of the Country —As a Result Wages are Soaring, Efficiency is Dropping and Unrest is Increasing

of *The Iron Trade Review* abounds with testimony; or if memory need be refreshed, the brief and pithy story of pig iron production and prices is amply sufficient. In 1915, the pig iron output of the United States was 29,572,194 gross tons; in the year just closed it was over 39,000,000 tons. On Jan. 1, 1916, basic iron was quoted at $19.45 in the Pittsburgh market; today the same commodity, in the face of a 50 per cent increase in production, stands at $30.95.

Our Labor Supply Cut Off

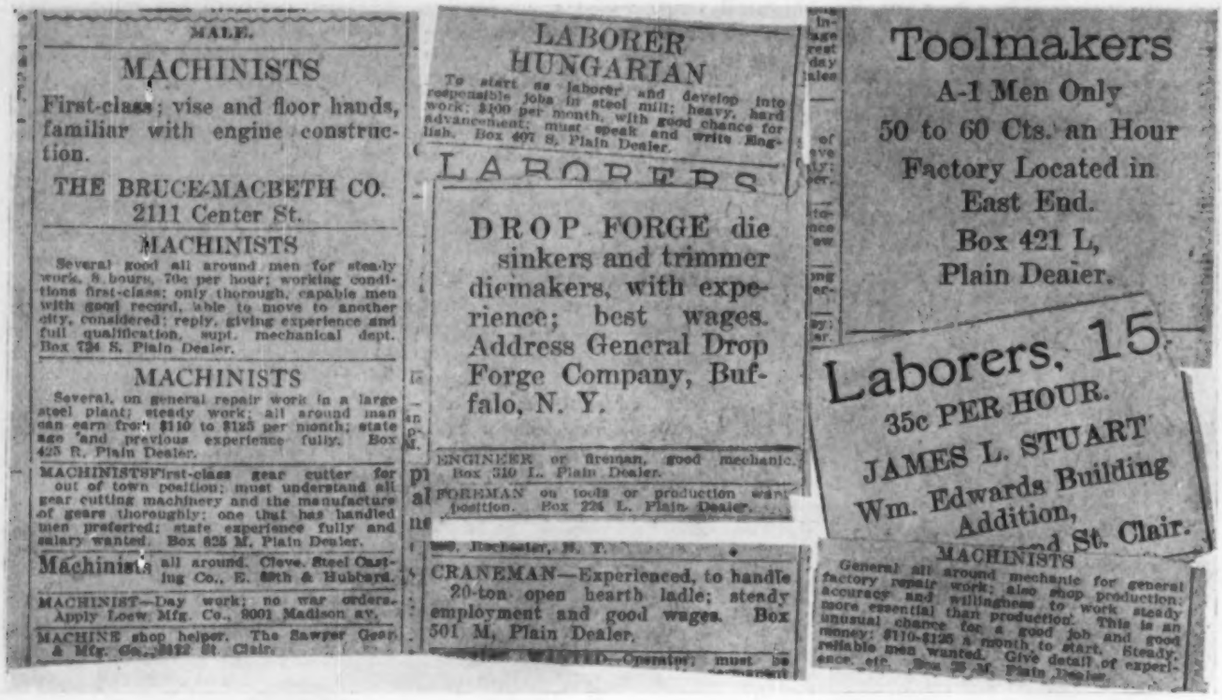
Immigration figures are possibly not quite so familiar, although they are fully as significant of the war's industrial upheaval. In the year ending June 30, 1914, exactly 1,218,480 foreigners sought our shores and workshops; in the next year, ending June 30, 1915, this great stream of energy had dwindled to 326,700, and in the twelve-month period closing with June 30, 1916, it had shrunk further to 298,226. The loss to industry represented by this phenomenon is incalculable. Expressed in wages alone it is over $2,000,000 *a day*. If the value of a man's production is roughly twice his wages we can express the loss of wealth as over a billion dollars a year and larger than the total expenses of the national government. But figures at the best mean little. Consider rather that before the war we received from Europe enough new workers every year to nearly fill a city the size of Philadelphia; today the annual influx would barely fill the city of Minneapolis.

Nor if we are blessed with an early peace, can we expect a normal flow of industrial energy from across the water for many months. No less authority than Frederic C. Howe, United States commissioner of immigration, has predicted that this country will become an emigrant rather than an immigrant nation at the close of the war. At all events, the readjustment will be painfully slow.

The effects of the shortage of labor resulting from the combined action of business prosperity and virtually no immigration are fully as patent as the causes on which they rest. Industry is face to face with the triple dilemma of high wages, reduced efficiency and vastly increased unrest. No business man can contemplate this situation with equanimity. High wages, of course, under existing conditions are the least of the burden and every thoughtful employer is glad to pay as much as he can rather than as little as possible. Such a course helps to cheer-up the individual John or Tony whose conglomerate opinion sways the mass. But at the same time John, for his own sake, must be induced to deliver the goods. He must be taught to give his work the very best that is in him; not merely enough to keep from being fired. But today there is no doubt John is a slacker, and a discontented slacker at that. We now are getting into the very core of the labor question—that great problem thrown into the peaceful arena of business by the belching of guns. If we revert to the colorless verbiage of the sociologist we can state the problem in another way: "How can we make labor both contented and efficient?" Obviously the answer, unless peace brings the familiar spectre of industrial stagnation in her train of virtues, does not lie on the surface.

Evolution Has Advantages Over Revolution

The number of laborers cannot be increased by fiat. Arbitrary wage reductions are impossible at present, as well as repugnant to American ideas of progress. Efficiency cannot be measurably increased by external pressure. In fact, it is almost self-evident that permanent relief can come only through slow processes tending to radically change Tony's attitude toward his job and his employer. These processes involve a number of factors. More intelligent employment methods are among the first requirements. The right kind of men must be selected, and then retained by giving them an easy avenue of communication with the management, thus nipping in the bud the little misunderstandings that frequently grow into strikes. Vocational training on a national scale is equally important. Finally, no enduring industrial edifice can be built in this country until Tony becomes one of us—until he is American-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Several good all around men for steady work, 8 hours, 70c per hour; working conditions first-class; only thorough, capable men with good record, able to move to another city, considered; reply, giving experience and full qualification, supt. mechanical dept. Box 726 S, Plain Dealer.

MACHINISTS

Several, on general repair work in a large steel plant; steady work; all around man can earn from $110 to $125 per month; state age and previous experience fully. Box 425 R, Plain Dealer.

MACHINISTS—First-class gear cutter for out of town position; must understand all gear cutting machinery and the manufacture of gears thoroughly; one that has handled men preferred; state experience fully and salary wanted. Box 825 M, Plain Dealer.

Machinists all around. Cleve. Steel Casting Co., E. 89th & Hubbard.

MACHINIST—Day work; no war orders. Apply Loew Mfg. Co., 8001 Madison av.

MACHINE shop helper. The Sawyer Gear & Mfg. Co., 3112 St. Clair.

LABORER HUNGARIAN

To start as laborer and develop into responsible jobs in steel mill; heavy, hard work; $100 per month, with good chance for advancement; must speak and write English. Box 407 S, Plain Dealer.

LABORERS

DROP FORGE die sinkers and trimmer diemakers, with experience; best wages. Address General Drop Forge Company, Buffalo, N. Y.

ENGINEER or fireman, good mechanic. Box 310 L, Plain Dealer.

FOREMAN on tools or production want position. Box 224 L, Plain Dealer.

CRANEMAN—Experienced, to handle 20-ton open hearth ladle; steady employment and good wages. Box 501 M, Plain Dealer.

Toolmakers
A-1 Men Only
50 to 60 Cts. an Hour
Factory Located in East End.
Box 421 L,
Plain Dealer.

Laborers, 15
35c PER HOUR.
JAMES L. STUART
Wm. Edwards Building
Addition,
St. Clair.

MACHINISTS

General all around mechanic for general factory repair work; also shop production; accuracy and willingness to work steady more essential than production. This is an unusual chance for a good job and good money; $110-$125 a month to start. Steady, reliable men wanted. Give detail of experience, etc. Box 28 M, Plain Dealer.

THE DEMAND FOR LABOR IS NO SHADOWY UNREALITY
A Few Help-Wanted Advertisements Clipped at Random from American Newspapers Early in December

ized and transferred from the unthinking mob into citizenship and responsibility.

Truly, this is a task for a series of generations. But now is the time to start. Had Sir Christopher Wren, in 1675, lacked the courage to begin, St. Paul's would not today tower over the gray walls of London. And just as a great cathedral is built stone by stone, and part of it occupied long before it is finally completed, the labor problem may be treated and solved. Also, while the evolutionary processes mentioned in the preceding paragraph are set in motion, certain temporary timbers can be quickly placed to prevent the foundation from caving in. In other words, labor ills can be cured permanently only by a long course of hygienic training, but in the meantime certain quick-acting specifics may be applied. But before going into the question of remedies in detail it is necessary, if we are to proceed intelligently, to examine the underlying facts more closely; those relating to wages, labor efficiency, and unrest should be studied with special care.

We all know that wages in the iron and steel industry increased a total of 33 per cent during 1916, but what does this actually mean in dollars and cents to Tony and to his employer? Take the employer's side first. The Steel Corporation is a shining example. Its total wage payments in 1914, a year of depression, were $162,379,906; in 1916 they exceeded $250,000,000. The increase represents the value of nearly 1,500,000 tons of steel at prevailing prices. Now since the Steel Corporation, roughly speaking, produces about half the tonnage, we find that the American iron and steel industry in the year just closed was forced to make 3,000,000 tons of steel and sell it in order to meet simply the *increase* in its wage bill as compared with 1915. So much for the employers. Tony's side of the bargain is even more interesting and significant.

In the manufacturing heart of the United States, New England, carefully compiled figures covering a large number of metal-working establishments show that in 1914 the common laborer—Tony, the hero of this monograph—earned from $1.85 to $2.25 for 10 hours of toil. Last year, and right now, he works one hour less and goes home with from $2.70 to $3.35, as a result of his day's exertions. The chances are, too, that he is now giving his employer about three-quarters as much work in a day as he did during 1914, providing he was fortunate enough to have any job at all in that distressing period. Furthermore, if the employer, at the present time, kicks about the returns, all Tony has to say is:

"I quit. You sorry."

It should be remembered that the figures given above are averages, and do not indicate the maximum. As one of the help-wanted advertisements reproduced with this article shows, early in December some employers were advertising for Hungarian laborers at $100 per month flat, and were glad to get them at that price.

Tony's more experienced and skillful comrade, Mike, who calls himself a machinist, is doing even better. If he is so fortunate as to live in our intellectual center—incidentally our munitions center—New England, his daily wage for eight hours amount to from $2.80 to $4, with a strong tendency toward the latter figure. If he is sufficiently industrious to work nine hours, he has a good chance to get time-and-a-half for the extra hour, in which case his daily returns amount to from $3.35 to $4.75, and in a majority of cases will be close to $4. In a prominent munitions plant in western New York the average wage, including all employes below the grade of sub-foreman, is $4.20 per day. At all events, Mike's weekly envelope for running a turret lathe or a single-purpose shell turning machine contains all the way from $15.40 to $25, and he either turns this sum over to his wife or squanders it at the corner groggery, according to his temperament and social development. The chances, under present conditions of easy money, unfortunately, are in favor of the groggery.

If Mike happens to live in Cincinnati, where machine tool manufacture is flourishing and where, also, there has been a dispute between the union machinists and their employers, he may even earn $4.80 or more for eight hours work. In Chicago he cannot do quite

A WELL ORGANIZED EMPLOYMENT DEPARTMENT IS ESSENTIAL IN MODERN BIG BUSINESS
Men Applying for Work at the Employment Department of the Illinois Steel Co. South Works, Chicago

as well, while in Moline, Ill., his wages will fully equal those obtained in New England manufacturing centers. Furthermore, the foregoing figures cover straight day-work by the hour. With the bonuses that are now common in piecework shops, Mike's earnings may easily reach $7 a day in eastern shell plants or in Detroit automobile factories. In brief, Mike, who actually has only about a quarter of the training required by a first-class machinist, is from $2 to $4 per day better off than he was two years ago. Such is the leavening effect of war on industry! Would peace produce contrary results?

Further facts regarding labor costs are unnecessary. Conditions are the same the country over and in any trade. If Mike turns molder and goes into the foundry game, his earnings are from $4 to $5.65 per day, as compared with $3.50 to $4 in 1914. The chances, however, are that he will shy from the sand heap, for generally speaking, foundrymen are still on the job nine hours a day, as they were during the hard times, and this amount of work in one day is not compatible with Mike's modern notions of social and economic progress.

To turn to another phase of our subject, we are told that labor is much less efficient under present conditions. Learned savants who have investigated this question venture to measure the loss in efficiency as approximately 20 per cent. Figures of this sort, no matter how accurate they may be, mean practically nothing. To be appreciated, the facts must be presented concretely, just as the whole labor problem must be approached concretely and individually.

Here is what decreased labor efficiency means to one foundryman in Detroit. On a certain afternoon in October, last year, the melt was unusually heavy. Iron was roaring out of the cupola spouts at the rate of 20 tons per hour. Soon the melter was up against it. He needed another man to help carry away the molten flood. Lacking time, he applied to the core room foreman for help. The latter worthy pointed out Stransky, handyman in the core department.

"Take him," he said.

Stransky was led away to the molding floor. But as soon as he found he was expected to carry iron, he balked. Such mule-like labor was beneath his dignity.

"I no carry iron," he explained simply, his stolid face showing no emotion.

"But you must! Big'um job!", urged the exasperated melter.

"I no carry. I go back to core room—"

"Damn you, if you don't carry and be quick about it, I'll—"

Again the unrelieved cadence of Stransky's monotones, "No like to carry ladle. You send me back to core room, or I quit, you have no man at all." And this, which was literally true, Stransky, the foreman and the melter well knew. Of course, in ordinary times Stransky would have been unceremoniously fired, but in these days production is all important and the big Pole held his job.

Furthermore, while the argument between the recalcitrant laborer and the melter was in progress, a ladle of iron stood on the floor and cooled. When it was finally poured, while the melter was busy elsewhere, it was far below the correct temperature and the castings were rejected by the machine shop.

Such is reduced efficiency in the concrete. Furthermore, the little drama just recited is being repeated daily in one form or another throughout the length and breadth of the land. Multiply this incident by ten or twenty thousand and you begin to have a dim conception of what reduced labor efficiency really means in the industrial life of the country. The whole problem may be summed up in a single interrogation:

How can we change Stransky's point of view and endow him with enough "team sense" to realize that his employer's interests and his own are identical?

There is another facet to this gem we have been examining that is even more important. The labor turnover has increased enormously. Frequently five men are hired every year to keep one job filled. Workers are continually shifting from job to job and from town to town in an endless search for a nonexistant eldorado. The losses due to

THE PRACTICAL SIDE OF THE AMERICANIZATION MOVEMENT

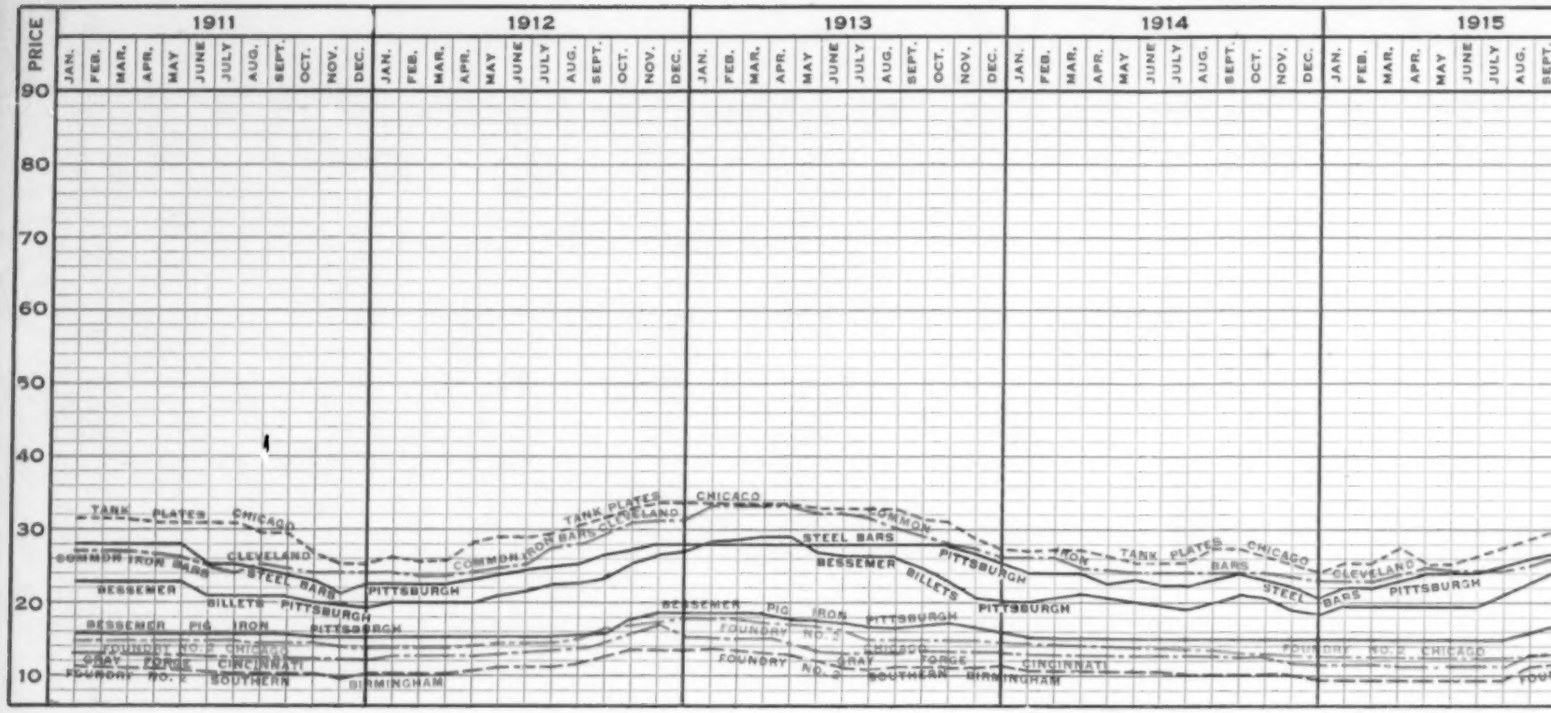
This Illustration Shows a Foreman in the Plant of the Michigan Bolt & Nut Works Answering a Puzzling Question as to Naturalization. He is Referring to the Booklet "Information for Immigrants in Detroit, Mich. Preparing to be American Citizens," Published by the Detroit Board of Commerce and Distributed Among the Foremen of the Large Industrial Plants of the City

THE IRON TR

CHARTS SHOWING FLUCTUATIONS IN IRON

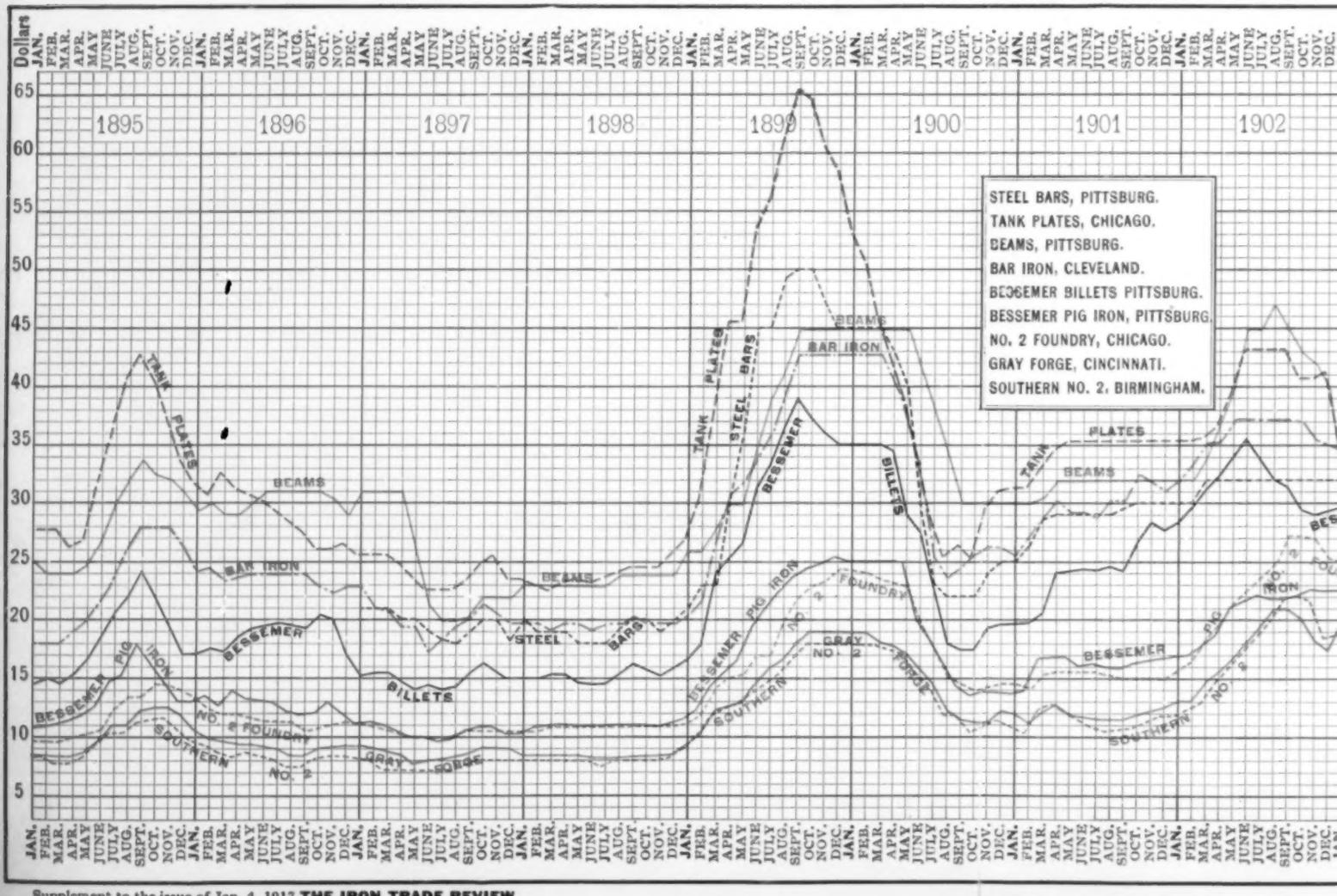
Charts Showing Fluctuations in Iron and S

(FINISHED PRODUCTS IN NET TONS.



Fluctuations in Iron and Steel Prices for

(FINISHED PRODUCTS IN NET TONS.

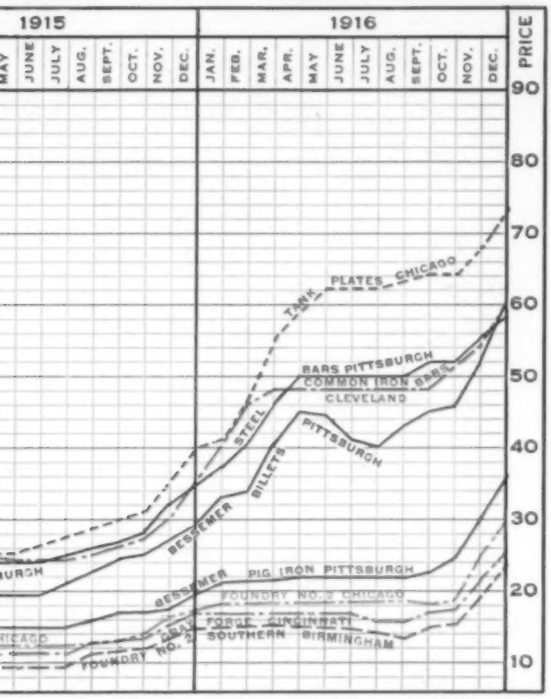


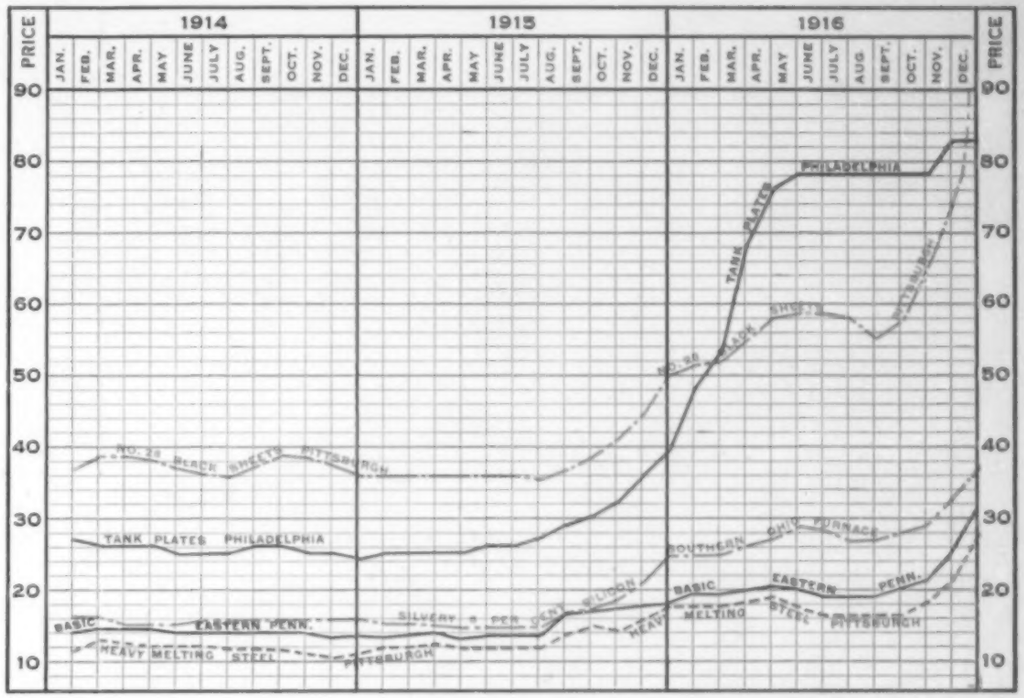
TRADE REVIEW

IRON AND STEEL PRICES FOR TWENTY-TWO YEARS

on and Steel Prices in 1911-12-13-14-15-16 By Months

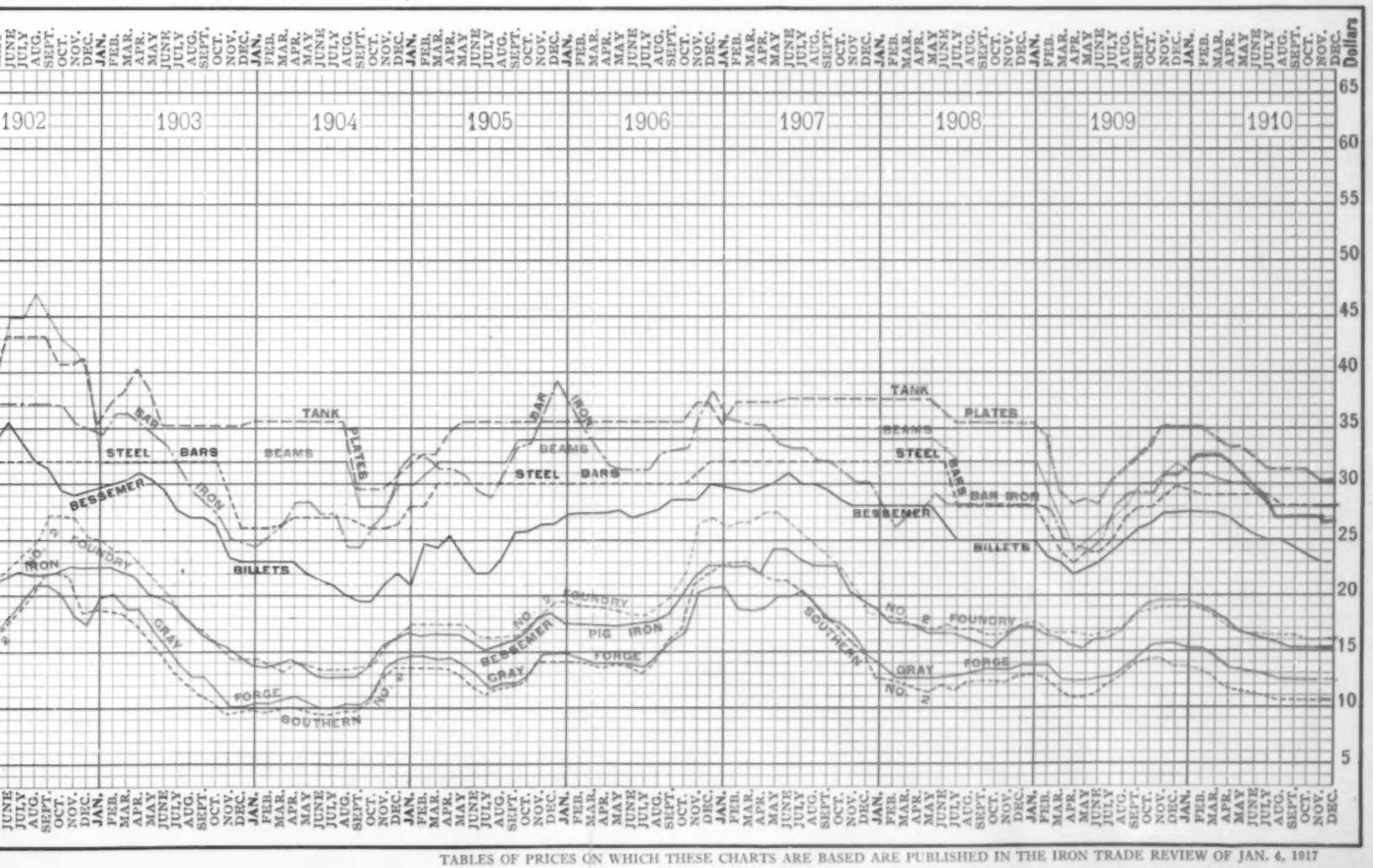
NET TONS. PIG IRON AND BILLETS IN GROSS TONS.)





Prices for Sixteen Years---1895 to 1910---By Months

NET TONS. PIG IRON AND BILLETS IN GROSS TONS.)



TABLES OF PRICES ON WHICH THESE CHARTS ARE BASED ARE PUBLISHED IN THE IRON TRADE REVIEW OF JAN. 4, 1917

unnecessary hiring and firing in American industry are almost unbelievable. Bad enough in normal times, today they are threefold worse. The most accurate data on this much misunderstood subject have been compiled by M. W. Alexander, of the General Electric Co.

For the year 1912, which may be considered to have been an industrially normal year, Mr. Alexander investigated a group of 12 prominent metal manufacturing establishments employing 37,274 hands on Jan. 1 and 43,971 on Dec. 31. The net increase in the working force as between Jan. 1 and Dec. 31 amounted to 6,697. But during this same period, 42,571 people had been hired and, accordingly, 35,874 had dropped out of employment for various reasons. In other words, in the twelve factories under review, about six and one-third times as many people were engaged during the year as constituted the permanent increase in the force. Over 40,000 people had to be engaged to increase the working force by less than 7,000! Remember, too, that these industries are generally considered to be above the average in many ways.

Of course, in a body of men as large as 40,000, there is considerable natural attrition. In order to compute the minimum number of people that it should be necessary to hire to maintain such a force and to increase it by approximately 6,700, Mr. Alexander assumes that among all employes 1 per cent die annually; 4 per cent are sick for sufficiently long periods to necessitate their replacement; 8 per cent withdraw from service for unforeseen or unavoidable reasons, or are discharged for justifiable causes; 8 per cent are temporarily needed on account of normal fluctuations of production; and 80 per cent constitutes a readily attainable efficiency of an employment department.

From the foregoing assumptions, it follows that while theoretically only 6,697 employes should have been taken on to allow for an increase of the working force from 37,274 to 43,971, the additional engagement of 13,843 persons, or a total engagement of 20,540 persons, would be justified to cover withdrawals by death, sickness, resignations, justifiable discharges and to account for practical employment results.

Yet the fact is that 42,571 persons were engaged where the employment of only 20,540 persons could readily be defended; 22,031 persons were, therefore, engaged above the apparently necessary requirements. It is obvious that a large sum of money must have been wasted in unnecessarily engaging so large a force of men and women. The picture will become at once more lucid and more appealing if the figures are given momentary values.

What It Means in Dollars and Cents

Mr. Alexander estimates that it costs $58.50 to hire and break-in an ordinary mechanic of fair skill and that it costs $73.50 to hire and break-in a piecework er. To engage a laborer costs $8.50. On this basis, classifying the employes previously mentioned, it is computed that the unnecessary engagement of 22,031 persons in one year in the 12 factories under investigation involved an economic waste of $831,030. This amount would be considerably greater and might easily reach $1,000,000 if the decreased profits due to a reduced production and the increase of expense on account of an enlarged equipment investment are taken into consideration. It is only from the thoughtful consideration of such facts as the foregoing that the full force of the reduction in efficiency resulting from unnecessary labor turnover becomes apparent.

Appalling as the loss just considered proves to be, it pales into insignificance compared with the social and economic waste resulting from labor unrest expressed in strikes, lockouts and industrial wars with their attendant trains of vice, murder, arson, riot and destruction. The year 1916 marked the climax in number, if not in seriousness, of labor disturbances in the United States. With a vengeance Tony made good his threat: "I quit. You sorry." During the past year he walked out and left his employer in the lurch 2,584 times between January and October, according to figures compiled by the United States bureau of labor statistics. Tony's restlessness is clearly shown by

PROGRESSIVE DETROIT EMPLOYERS KEEP POSTED
Every Week Non-English-Speaking Employes Present Attendance Cards Showing that they Have Faithfully Attended Night School Where English is Taught

comparing this activity with 1915, when during the entire year he struck only 916 times.

The results of all this waste are discouraging from any point of view. Frank A. Vanderlip says that in a single year the losses that can be attributed to labor troubles in this country total more than a billion dollars. "Of course," the eminent banker concludes, "the real losses that many be traced to the friction in the social order that exists from this one cause alone are beyond computation." Indeed they are. And the workingman is virtually no better off when the year's weary round of strikes is completed. In August, 1916, according to the bureau of labor statistics, with conditions unusually favorable from the employes' standpoint, out of 125 strikes reported as settled only 35 were won. The record shows that Tony and John strike joyously, at the least provocation, but usually they go hungry as a result. In a rough way the facts regarding the labor situation as it exists in this New Year, 1917, have been sketched out. The diagnosis is complete. The patient is better fed than ever before, but he refuses to apply himself with any regularity and is exceedingly nervous and dissatisfied. What shall the remedies be? Let's first look into the benefits to be derived from quick-acting specifics.

With no chance to import labor from Europe, it is self-evident that the supply of man-power cannot be horizontally increased. One would think that the first natural course to take under these circumstances, would be to organize existing labor sources so that at least the demand and supply would be equalized throughout the country and all possible labor-effort fully utilized. Such is not the case. The average employer possesses only the vaguest of ideas regarding his logical sources of labor. In ordinary times he depends on the chances of the street, and hopes to cull enough workers from the mob that drifts by his door to keep his plant in operation. And in ordinary or subnormal times this method works out fairly well, except that little can be expected in the way of efficiency or team work from a force recruited in this manner. In times like the present this haphazard system breaks down entirely. The good workmen are all snugly housed and the pickups from the street are generally confined to worthless roustabouts. Under these conditions, the employer's only salvation lies in the careful organization and continual cultivation of his natural labor sources, enlisting such aids as reliable public employment bureaus, co-operative employment agencies, the public schools, foreign societies, etc. No help can be expected from labor unions; these organizations have not yet evolved to the point where they can be depended upon for any tangible service. Their chief mission at present is to agitate and stir up trouble.

It would be better, however, to fall back on the unions than to follow the plan pursued by the average industrial manager when the street supply of labor gives out. Under such circumstances this gentleman usually resorts to the time-honored practice of robbing his neighbors or competitors. Nothing could be more futile. The only effect of such a procedure is to manufacture floaters and compound inefficiency. Furthermore, hiring men away from the other fellow can be worked both ways and the net result is a cipher with the rim off. If manufacturers want to quickly improve the labor situation, they will cut out senseless bidding against each other and co-operate to organize their natural, local sources of labor supply. Most employers who have gone into the subject at all deeply have found that their best labor source exists right in their own organization. Birds of a feather flock together and if the workmen in a given shop are contented and satisfied with their jobs and their surroundings, they will urge their friends to try and obtain places in the same organization. Of course, if they are not satisfied, their recommendations are likely to be of an opposite character, which only further emphasizes the need of working with and not against your employes. If you can recruit your organization largely from within itself, you will find it is comparatively easy to create a tendency that will gradually raise your entire force to a higher level. So much for the first quick-acting remedy. Organize your labor sources.

Assuming now that men are treated fairly and paid liberally, is there any effective, rapid-fire method of quelling unrest and forestalling the mutually disastrous results of strikes? Yankee fashion, we will answer this question by asking another: Why not call in that master strategist, General Publicity? The railroads have used him effectively and have found that he commands a matchless weapon, forged ready for use —the press. The power of printer's ink has been demonstrated repeatedly by labor agitators. Why not meet these

American Wages in 1916

THE FIGURES GIVEN BELOW REPRESENT A CAREFUL AVERAGE OF RETURNS FROM A LARGE NUMBER OF EASTERN METAL WORKING ESTABLISHMENTS

	—Rates of pay per hour—cents—			
	Lowest in any shop.	Average minimum.	Highest in any shop.	Average maximum.
Assemblers, bench	12½	19	35	32¾
Assemblers, machinist	25	29¼	50	44¾
Bench or vise hands	19½	22¼	38¾	30¼
Machinists, all around	22½	30½	50	38½
Tool and die makers	31½	36¾	60	49¾
Model makers	49	49½	60	53¼
Sub die makers	40	....	50	....
Machinist blacksmiths	32	34¼	45	39¾
Tool blacksmiths	38	....	38	....
Forgers	....	....	30	....
Hardeners	23	27	45½	38
Die sinkers	30½	....	63	51½
Drop forgers	22¼	26½	63	49
Brass polishers	17½	25¾	40	38¼
Brass buffers	27½	29¼	40	36½
Brass platers	19	21¾	36½	32½
Iron polishers	32	....	38	....
Iron buffers	19	....	28	....
Iron molders	36	37½	50	48½
Brass molders	25	28¼	45	41
Core makers	20	29½	47	35¼
Bench filers	19½	23½	30¾	34
Scrapers	20	20	31½	29½
Inspectors	19	23¾	41	32¾
Testers	19	....	41	35½
Wood patternmakers	25	31½	48	40¾
Metal patternmakers	32½	....	48	40½
Millwrights	28	30¼	44	37¼
Lathe hands	22½	26	48	39¾
Planer hands	22½	30	50	36
Boring mill hands	22½	29	47½	36
Milling machine hands	18	21¼	35	31½
Shaper hands	25	29	40	39
Cylinder or universal grinder hands	26½	....	40	37
Automatic screw machine hands	22½	27½	60	40½
Hand screw machine hands	18	23½	34¼	30¾
Power press operators	11½	17¼	36	30¼
Foot press operators	10	14¼	32	24¾
Metal spinners	32½	....	35	....
Machinery painters	18	....	34	29
Handymen and helpers	17	18½	30	26
Machinist foremen	30	41½	1.00	57½
Toolmaker foremen	35	....	70	59
Automatic screw machine foremen	34	36	60	56½
Any mechanic in authority	30	35	72¼	55½

gentry on their own ground? Had the agitators' propaganda in its earlier stages been met with effective, sledge-hammer counter-attacks, many of the disturbances of today would never have come to a head. The truth should be told about the employers' side of the labor problem; and the truth should be driven home persistently and insistently. The day for dignified, capitalistic silence has passed. It is high time for a backfire.

There has been a miners' strike of varying intensity on the Mesabi iron range for nine months. In its acute stages it was accompanied by killings and other distressing events that invariably occur coincidently with such disturbances. The lurid side of these affairs has been published far and wide, greatly damaging the good will and prestige of the corporations concerned. These corporations are dependent for their ultimate existence on a friendly public opinion, yet they supinely permit the circulation of slanders and foul falsehoods and make practically no effort to lay the facts before the people. The widespread publication of garbled statements regarding a single check for a few dollars paid to a contract miner on the Mesabi range, accompanied by reproductions of the check itself, has stirred up feeling to the point of anarchy and immeasurably injured the cause of the mining companies. It is of such stuff that riots are fashioned. Yet it would be comparatively simple to present the facts regarding this transaction in their true light. And so would it be with the entire iron range situation. Readers of this publication are familiar enough with labor and social conditions on the Mesabi range. It is doubtful if there is a metal mining community anywhere else in the world that offers so many advantages to the worker. The mine operator's side of the iron range strike is impregnable. All it needs is presentation.

Such presentation of facts, however, in this or any other dispute must be handled resolutely. Half measures and temporizing are worse than inaction. It is no task for the amateur in publicity.

Sure Results from Bonus Systems

Talk to the people through the press and one of the great causes of general social unrest will be removed. But in dealing direct with your own employes, one of the most effective methods of keeping them contented is a carefully worked out bonus system, whereby a liberal minimum wage is guaranteed and extra distributions are made according to output. The Ford Motor Co. is a classic example of the temperamental effect of bonuses. This organization has yet to experience a labor disturbance. Furthermore, the labor turnover has been reduced in four years from 400 per cent to 23 per cent; mute figures that eloquently testify to the transformation of a working force of over 15,000 men from indifference to loyalty. You must hold your men. Just as quicksand cannot be kneaded into a solid lump, so also will it be found difficult to take hold of an ever-changing mass of employes and transform it into a homogeneous, intelligent, contented body. Moreover, constant shifting nullifies the beneficial effects of many well-intentioned efforts of employers, such as sickness and accident insurance plans, old age pensions, savings plans, etc., thus adding fuel to the flames of unrest.

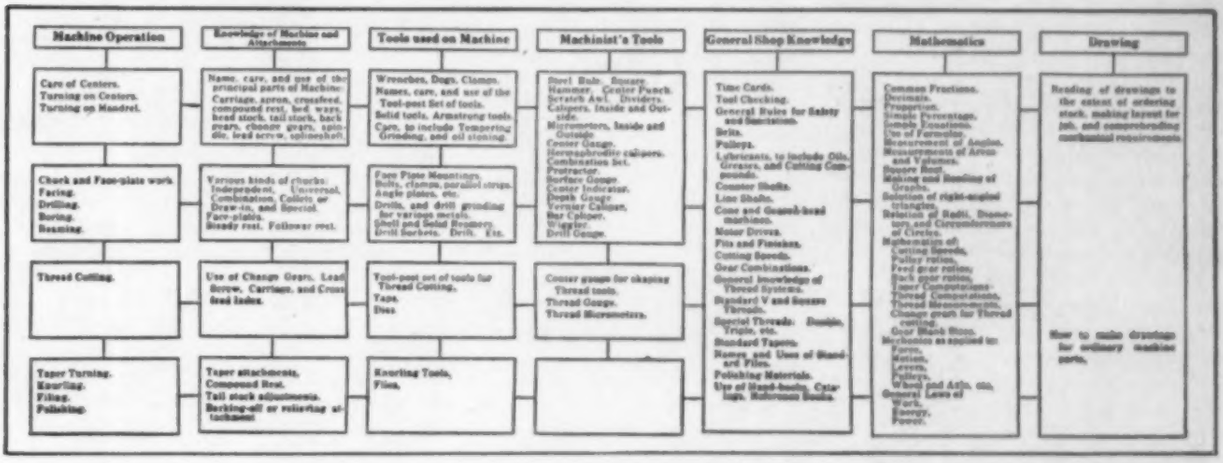
Little space remains to discuss methods of permanent relief from labor difficulties. Naturally, however, more thought has been given to this phase of the general problem than to definite plans suitable for immediate application to the existing situation, such as have just been discussed. Permanent remedies must be applied, however, if any finally satisfactory results are to be achieved.

All plans looking toward lasting results must be based on the serious recognition of the fact that the greatest business problem in America today is the labor problem. It is the outstanding human problem of the century. Here lies the greatest opportunity and also the greatest danger confronting modern industry. On the one hand, lie the possibilities of steady production, co-operation, contentment and good will; on the other, the possibilities of strife, of social revolt and even the wrecking of the present organization of business. Syndicalism and socialism are more than empty shadows. Their forces must be reckoned with in any scheme for the permanent settlement of the great dispute over the division of the economic surplus.

First of all, if we are seeking enduring results, employment methods must be changed, systematized and improved. In large organizations it would be well to give the employment manager a seat at the board alongside the production manager and the sales manager, and to assure him of direct access to the general manager. Through his efforts, the labor turnover should be cut to the bone; promotion plans that stimulate contentment should be worked out; training systems for old and new employes should be instituted; and a channel of communication should be opened up between the management and the worker, with no check-valves to stop the upward flow of ideas and suggestions.

If the overwhelmingly disastrous Colorado strike proved anything, it demonstrated once for all that in large organizations some artificial substitute must be provided to take the place of

(*Concluded on page 39.*)


Machine Operation
Knowledge of Machine and Attachments
Tools used on Machine
Machinist's Tools
General Shop Knowledge
Mathematics
Drawing
Care of Centers.
Turning on Centers.
Turning on Mandrel.
Chuck and Face-plate work.
Facing.
Drilling.
Boring.
Reaming.
Thread Cutting.
Taper Turning.
Knurling.
Filing.
Polishing.
Name, care, and use of the principal parts of Machine: Carriage, apron, crossfeed, compound rest, bed ways, head stock, tail stock, back gears, change gears, spindle, lead screw, splinehold.
Various kinds of chucks: Independent, Universal, Combination, Collets or Draw-in, and Special. Face-plates. Steady rest. Follower rest.
Use of Change Gears. Lead Screw, Carriage, and Cross feed index.
Taper attachments. Compound Rest. Tail stock adjustments. Backing-off or relieving attachment.
Wrenches, Dogs, Clamps. Names, care, and use of the Tool-post Set of tools. Solid tools. Armstrong tools. Care, to include Tempering, Grinding, and oil stoning.
Face Plate Mountings. Bolts, clamps, parallel strips, Angle plates, etc. Drills, and drill grinding for various metals. Shell and Solid Reamers. Drill Sockets. Drift, Etc.
Tool-post set of tools for Thread Cutting. Taps. Dies.
Knurling Tools. Files.
Steel Rule. Square. Hammer. Center Punch. Scratch Awl. Dividers. Calipers, Inside and Outside. Micrometers, Inside and Outside. Cooper Gauge. Hermaphrodite calipers. Combination Set. Protractor. Surface Gauge. Center Indicator. Depth Gauge. Vernier Caliper. Bar Caliper. Wiggler. Drill Gauge.
Coarse gauge for shaping Thread tools. Thread Gauge. Thread Micrometers.
Time Cards. Tool Checking. General Rules for Safety and Sanitation. Belts. Pulleys. Lubricants, to include Oils, Greases, and Cutting Compounds. Counter Shafts. Line Shafts. Cone and Geared-head machines. Motor Drives. Fits and Fitting. Cutting Speeds. Gear Combinations. General knowledge of Thread Systems. Standard V and Square Threads. Special Threads: Double, Triple, etc. Standard Tapers. Names and Uses of Standard Files. Polishing Materials. Use of Hand-books, Catalogs, Reference Books.
Common Fractions. Decimals. Proportion. Simple Percentage. Simple Equations. Use of Formulas. Measurement of Angles. Measurements of Areas and Volumes. Square Root. Making and Reading of Graphs. Solution of right-angled triangles. Relation of Radii, Diameters, and Circumferences of Circles. Mathematics of: Cutting Speeds, Pulley ratios, Feed gear ratios, Back gear ratios, Taper Attachments, Thread Computations, Thread Micrometer-use, Change gears for Thread cutting, Gear Blank Sizes. Mechanics as applied to: Force, Motion, Levers, Pulleys, Wheel and Axle, etc. General Laws of Work, Energy, Power.
Reading of drawings to the extent of ordering stock, making layout for job, and comprehending mechanical requirements.
How to make drawings for ordinary machine parts.

MACHINIST'S REQUIREMENTS FOR ENGINE LATHE WORK

Shop Maintenance, Then and Now

Modern Methods of Keeping High Production Tools on the Active List Differ Greatly From Practices Ten Years Ago—Time Saving Has Become Aim of Shop Operators

BY RALPH H. JONES

JOE PINNELLI, who needed the job badly, vowed, by all the saints he knew, that running an engine lathe for him was child's play. The shop superintendent was skeptical but also short handed and Joe went to the timekeeper for his card.

Now Joe's intentions were good; he really knew an engine lathe when he saw one, and he might have been able, in an emergency, to rough turn a piece of plain work. His previous experience, however, with machines of this type, had been limited to emptying chip pans and carrying cutting oil, but that did not deter him from making good his bluff. He made a futile effort at chucking the work given him —he hoped no one was looking— pushed down all the levers that would go down, pulled up the others, turned one or two hand wheels, drew a long breath and slapped on the power.

After the noise had subsided and the shop superintendent had become more nearly normal, an examination disclosed that two of the back gears had been chewed up considerably and that a dozen or more teeth in the gears had been smashed. The toolmaker, an all around machinist and repair man, was summoned and a thorough inspection of the damaged machine was made.

In the machine shop of 10 or 20 years ago it was the custom to employ such a repairman who did little else but keep the shop equipment in running order. Sometimes, when things happened all at once, two, three or four men gave all their time to replacing or repairing broken parts. Their work was slow and costly. Machines were often tied up for a week but since the shop was seldom pushed for production, in the modern sense, the management was content to follow the groove and preferred to make its own parts. The machinist's work was varied and his daily task comprised anything from making drawings and blueprints of a new gear to finishing a pattern for a lathe leg.

In many cases shops were located in isolated communities and from force of necessity had to be self-contained. There were no fine lines of discrimination between a machinist, a mechanic and a toolmaker. The shop employe was a combination of all three. He tackled the most difficult repair job and made some sort of a success of it; he was slow and painstaking in his work; time meant little to him save that it was the unit of space in which work was to be done; high-speed tools were just a little out of his line but he would make you a new set of back gears or even a lead screw with almost as great a degree of accruacy as those in your old machine. His methods of shop maintenance were unique, slow and thoroughly satisfactory.

Methods Have Changed

Modern systems present striking contrasts to the old methods of shop repair. The up-to-date machine is built to withstand the abuse of high production and the ignorance of some operators. Breakdowns of a serious nature have been by no means entirely eliminated, but neither are they so numerous. When accidents do occur the insert, in the accompanying illustration, shows the way that such emergencies are met. The shop superintendent calls the tool builder by long distance telephone, describes the equipment which is needed, gives the builder the serial number which is stamped on each part of the machine and urges that parcel post or *rush* express be used to forward the parts in the shortest possible time. If breakdowns are of a minor nature the work is turned over to a staff of repair men whose duties are to keep the shop equipment in the highest state of efficiency.

Production has been the slogan of the machine shop for the past two years and a half and tool breakdowns constitute one of the greatest bugbears of the modern shop operator. In the plant of a New York shell manufacturer every device for the continuous operation of shell turning equipment in particular and machine tools in general has been installed. If a tool is seriously crippled and cannot be repaired on the floor, the "jitney", a manually operated truck, is summoned and the disabled machine taken to the tool room. In order that no drop in production may take place, either a new tool or an old one from the reserve stock is sent out to the floor where it is retained until repairs have been made and the damaged machine ready for service again. Where machines are operated by means of a motor-driven line shaft and an accident damages the motor, an auxiliary power unit is maintained for use in such emergencies. This reserve motor is so mounted on a truck that after securing the truck and motor to the floor by means of lag screws the line shaft may be again set to work. In such a plant a stock of machine parts is kept on hand at all times and it is seldom that demands have to be made upon the factory for rush orders. Occasionally cases arise that make it imperative that parts be obtained from the builder, and in nearly every instance, the entire transaction is completed by telephone or telegraph to save time.

Much has been said about the passing of the old time all-around machinist and the recent predominance of the specialty mechanic whose training is confined to a single line. Many theories have been advanced as to the probable cause of this state of affairs and some writers on the subject have blamed modern shop methods for the change. The difference in the methods of shop maintenance of 10 years ago and the systems practiced in the modern plant is not a result of a shortage of men capable of doing repair work of a difficult nature, but because economic practices have undergone radical changes. The modern tool room is certainly better equipped to repair or even build complete a modern lathe than the tool room of 20 years ago, but the relation between the cost of making extensive repairs and the cost of making a replacement of a part is the important consideration. Cost may be reckoned in units of lost production. For instance, a small part might easily be made in three days at an outlay of $20 but in the meantime a valuable machine would be idle. This same part might be listed at $40 by a dealer who could supply it on a moment's notice. Since output is all important the more expedient course is invariably chosen.

We are living in the age of production. Methods of maintenance fully as efficient and certainly more conservative have been relegated to the background to make room for the system which tolerates no time-wasting breakdown for either machine or man.

THE MACHINIST OF YESTERDAY, THAT MASTER MECHANIC OF REPAIRS, OFFERS A STRIKING CONTRAST TO THE SHOP SUPERINTENDENT OF TODAY

The Railroad Yard—The Neck of the Transportation Bottle

Teamwork—a Cure for Traffic Ills

Lack of Adequate Railroad Facilities is Throttling the Iron and Steel Business —Relief Can Only Come From Co-operation by the Roads to Obtain Maximum Service From Their Resources

BY E. L. SHANER

WHEN the tremendous movement of export freight demoralized the eastern terminals late last winter, the preparedness of our great transportation system was tried and found wanting. Now, nearly a year after that costly experience, we find the railroads are again unable to handle traffic satisfactorily. They cannot provide enough cars to meet the requirements of shippers.

The situation existing in the early months of 1916 was almost entirely independent of the supply of cars, although for a short period in February and March a net shortage was reported. The trouble was caused by the indiscriminate use of equipment for export goods, lack of adequate terminal facilities, inefficient loading and unloading of material, and lack of dispatch in handling cars. Fortunately, at least a few of the mistakes of that crisis have not been repeated in the present difficulty. On the other hand, the general problem of transportation has not been settled, although the actual obstacles to its solution are more clearly defined.

In studying the traffic problem, it is interesting to note that of the various commodities that make up the tonnage annually hauled on the railroads, the products of mines represent the greatest percentage. Bituminous coal constitutes about 29 per cent of the tonnage handled. Ore, including iron, copper, lead, etc., represents about 8 per cent; coke, 3.5 per cent; pig iron and blooms, 1.25 per cent; iron and steel rails, 0.5 per cent, and castings and machinery, 1.5 per cent. Dividing the commodities into more general classifications, the percentages are as shown in the accompanying table.

The Traffic Demand is Unusual

This table easily explains several features of the present car shortage. Coal, coke and ore, commodities representing about 50 per cent of the total tonnage hauled by the railroads, have been produced in greater volume this year than ever before. Some idea of the increased tonnage of these materials is gained from the figures furnished by a large carrier operating in the manufacturing district of western Pennsylvania and eastern Ohio. This road hauled 36,000,000 tons, of coal during nine months in 1916, as against 31,000,000 during the corresponding period of 1915. Coke shipments during the same period in 1916 amounted to nearly 11,000,000 tons, and only 8,400,000 in 1915. Anthracite coal shipments were 8,800,000 tons in 1916 and 7,600,000 in 1915. Most of the ore from the Lake Superior region is carried to the lower lake ports by boat and then hauled by rail to furnaces in the middle Atlantic states. That over 50 per cent more iron ore was handled in 1916 than in 1915 is conclusive proof that in spite of the tremendous demand for cars for other purposes the railroads rendered unusually good service to the furnace interests in promptly handling ore.

Moreover, the railroads handled unusually heavy tonnages of less important materials. Shipments of lumber from the northwest were larger than ever before; the grain movement in 1916 exceeded that of 1915 by a noticeable percentage; and the tonnage of building materials was far above normal. Add to the increased tonnages of these materials the burden of export traffic, which increased in value from $750,000,000 in the year before the beginning of the war to $2,907,800,000 for the year ending June 30, 1916, and it is apparent that the railroads have been contending with an unsual problem.

Direction of Traffic Reversed

Furthermore, the war has changed the regular currents of traffic. The diverting of coastwise ships to more productive fields has caused many shipments heretofore handled by water to be sent by rail. On the great lakes, ore carriers which in normal times were glad to carry coal on the return trip to the head of the lakes, during the past season were attracted by the higher rate for ore and many did not wait to load up with the fuel. As a consequence, much of the coal supply for Duluth, and the other points in the northwest which heretofore came from the Pennsylvania districts by lake, is now shipped by rail from the Illinois fields. Pennsylvania coal is going to

THOUSANDS OF CARS TIED UP IN THE EAST HAVE CAUSED A SHORTAGE IN THE MIDDLE WEST

eastern manufacturing centers and Illinois coal is now shipped to Ohio, thereby completely reversing the direction of shipments. Low water in the Ohio river has decreased the shipment of coal to cities in the lower Ohio valley, and consequently the supply for these centers must be shipped by rail from other fields.

System is at Fault

From this review, it is evident that the carriers are confronting an unusual situation. That they have not met the emergency in a more satisfactory manner is due not only to their inability to handle cars more efficiently, but to the inadequacy of the general scheme of transportation in vogue in the United States. We have several hundred different companies, pledged to interchange cars under certain conditions, and subject to the regulation of a federal commission which specifies rates and requires a certain minimum of service. Although as individual companies, most of the roads have effected considerable increases in the efficiency of operation, the composite result from a transportation standpoint has been disappointing. Teamwork is the factor that is sadly lacking in the system as it stands today. While it is certainly gratifying to learn that many of the roads have increased the average car mileage per day from 25 to almost 40 miles, that the average train haul has been increased, and that the average lading per car has been raised by several tons, the good effect of these records is lost in the inharmonious relations existing between the various companies.

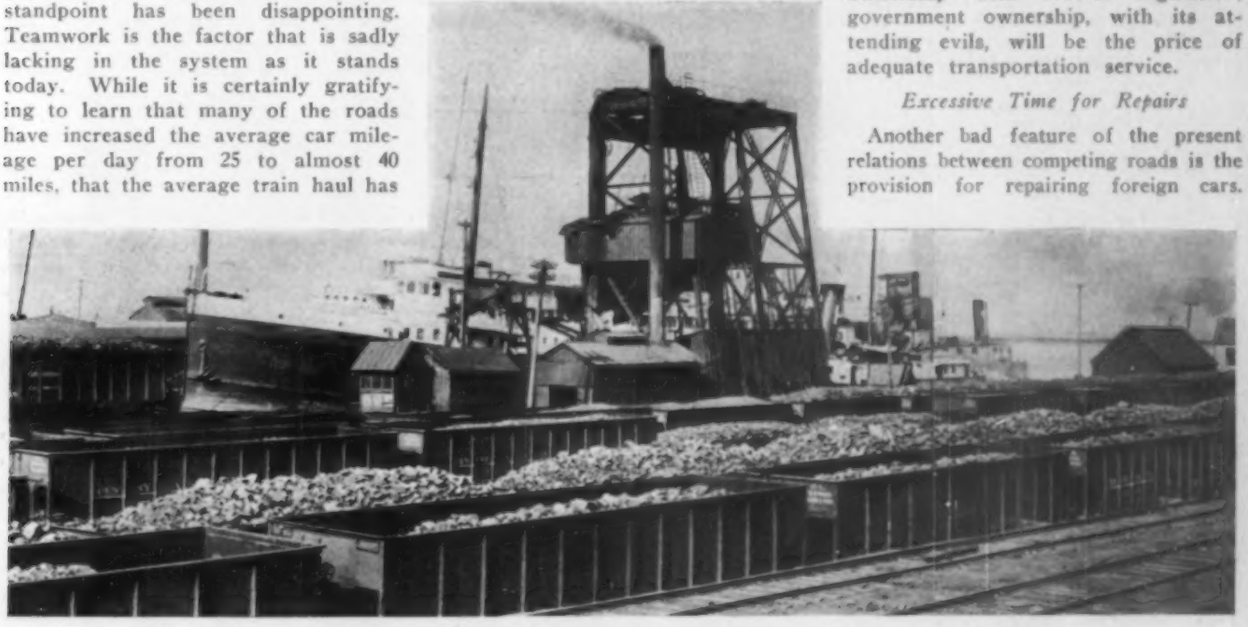
Teamwork is Lacking

The lack of co-operation is evident in every phase of the present crisis. It is reflected in the refusal of roads to promptly return cars to their owners, in the clumsy and unsatisfactory arrangement for repairing foreign cars, in the point-blank refusal of companies to switch cars to other roads, and in the lack of united effort to utilize the vast number of idle cars during the periods when railroad business falls off.

As proof of this absence of effective co-operation between competing lines, we find that the old-fashioned trick of using the other fellow's car when it is more profitable to pay the per diem rate than to route it home is now being played to the limit. On Sept. 1, 1916, over 55,000 of the 160,000 open cars owned by the Pennsylvania system were on foreign roads. The Louisville & Nashville on Oct. 28 had only 39 per cent of its own coal cars on its tracks, and allowing for foreign cars on its lines, had only 51 per cent of the total number of coal cars it owned. Railroads in the United States are paying $4,500 penalty daily to the Canadian Pacific for the non-return of its cars, and the Canadian road has refused to allow any more of its cars to cross the border. As long as the competitive spirit of the indidvidual companies prevents them from utilizing each other's property to its greatest capacity, the transportation problem will not be solved. The pooling of cars is necessary to efficiency, and if this cannot be accomplished under corporation ownership with federal regulation, government ownership, with its attending evils, will be the price of adequate transportation service.

Excessive Time for Repairs

Another bad feature of the present relations between competing roads is the provision for repairing foreign cars.



ABOUT 30,000,000 TONS OF COAL ARE CARRIED FROM THE MINES TO THE LAKES EACH YEAR

When a car from another road is received, for extensive repairs, the holding carrier must secure authority from the owner to perform the work. Even if authority is given promptly, there is usually a loss of time while material is being shipped from the shops of the owning road. If a holding company makes repairs without authority, it is open to pay a penalty for "wrong repairs". N. D. Ballantine, in an article in the *Railway Age Gazette* states that an actual record of over 100 cars repaired by a certain western road show that the cars were out of service for an average period of 69 days. On a conservative estimate, the repairs could have been made in 22 days; therefore, the cumbersome system of foreign car repair in this single case caused a net loss of 2,700 car days. It is evident then that in spite of the remarkable organization built up by the Master Car Builders' Association, there is a deplorable lack of efficiency in the interhandling of cars.

Another proof of the lack of cooperation is the refusal of companies to perform the usual switching services. For several weeks the papers have been citing cases similar to the following:

"Lines like the Pennsylvania system are refusing point blank to move cars from one works to another within the city limits even when the cars actually are loaded and standing on the mill side track. In one case, a foundry in one section of Cleveland had a car standing loaded with castings for Detroit, and the Pennsylvania refused to move them, or even transfer the car to the Wheeling & Lake Erie that offered to accept the shipment, intending by a roundabout route to get it to Detroit. The castings had to be teamed through the city to the Wheeling & Lake Erie tracks before they could be started on their way. One mill has coal in cars on sidetracks inside the city, but cannot get it moved to the plant."

It is evident that cases of this kind are caused by the suspicion existing between the various roads. Companies refuse to transfer their cars on other lines in the same city because they feel that they cannot afford to lose the use of their own equipment. It is the same feeling that has caused the Canadian Pacific to refuse to allow its cars to cross the border, and is one of the reasons why embargoes are placed on certain commodities.

Better Distribution of Cars

The greatest benefit of practical co-operation between the roads would be the ability of the harmonius system to distribute cars more efficiently. From the records of past years it is evident that the railroads have a surplus of from a few thousand to several hundred thousand cars during the period from January to the early part of September. In October, November and December a shortage rarely exceeding 50,000 cars sometimes occurs. The problem for the railroads, if they could look at it from the standpoint of their mutual benefit rather than from the viewpoint of competing corporation, is one of utilizing the idle cars during the first eight months of the year. James J. Hill had the right idea in railroading when he developed the territory traversed by his lines so that he would have traffic for his cars during the dull seasons. The roads should combine their resources so that the equipment is distributed to the best advantage.

An example of what can be accomplished in this respect is furnished by the diverting this year for the first time in history the 17,000 cars of the Minnesota ore ranges into the coal-carrying trade. Heretofore these cars have been held in the shops of the owning roads for repairs during the period of closed navigation. This year they will be used to relieve the coal car famine in the middle western states. In the spring, when the annual surplus begins to mount up, they will be returned to the ore-carrying roads of the northwest to be ready for the opening of lake traffic in April.

What Constitutes the Freight Car Burden?

The lading of the 2,400,000 freight cars in the United States includes:

	Per Cent.
Coal, coke, ore, stone, sand, etc....	54.50
Petroleum, pig iron, blooms, iron and steel rails, bar and sheet metal, castings, machinery, etc..	15.75
Lumber	10.00
Grain, flour, hay, cotton, fruits and vegetables	10.00
Merchandise and miscellaneous.....	7.50
Live stock, dressed meats, wool, hides, leather, etc.....	2.25
Total	100.00

A suggestion which offers relief in a novel, but not altogether impractical way, appeared in a recent issue of *Coal Age*. It follows:

"How would it be if the next time the miner asks for an increase to suggest to him a differential between winter and summer? By paying the miner higher wages in the winter, the price of coal would automatically favor summer purchasing. And why, when freight rates are raised, which is sure to happen soon, could not the railroads arrange to put all that increase on the winter service? The railroads would gain immensely by regularity of operation, which would enable them to keep their equipment in continued profitable operation and their employes steadily at work. It would also increase their traffic at the one period of the year when it is conducted at least cost and with least loss. The coal operator is the only factor that is making concessions to correct the seasonal demands of the industry, and he will continue to contribute liberally toward regularity of production."

Of course, the suggestion is open to some objections, but in the main it is sound. Naturally, the effect of such a policy would be negligible in an abnormal time like the present, because comparatively high prices prevail in all commodities. Coal could have been purchased last summer at a reasonable rate, but now consumers, both for manufacturing and domestic use, are paying exorbitant prices in their mad endeavor to keep a supply equivalent to their requirements. In normal times, when supply and demand are more evenly balanced, and when prices are not inflated by extraordinary conditions, the remedy outlined above would, undoubtedly, have a beneficial effect upon the country, and would improve the car situation.

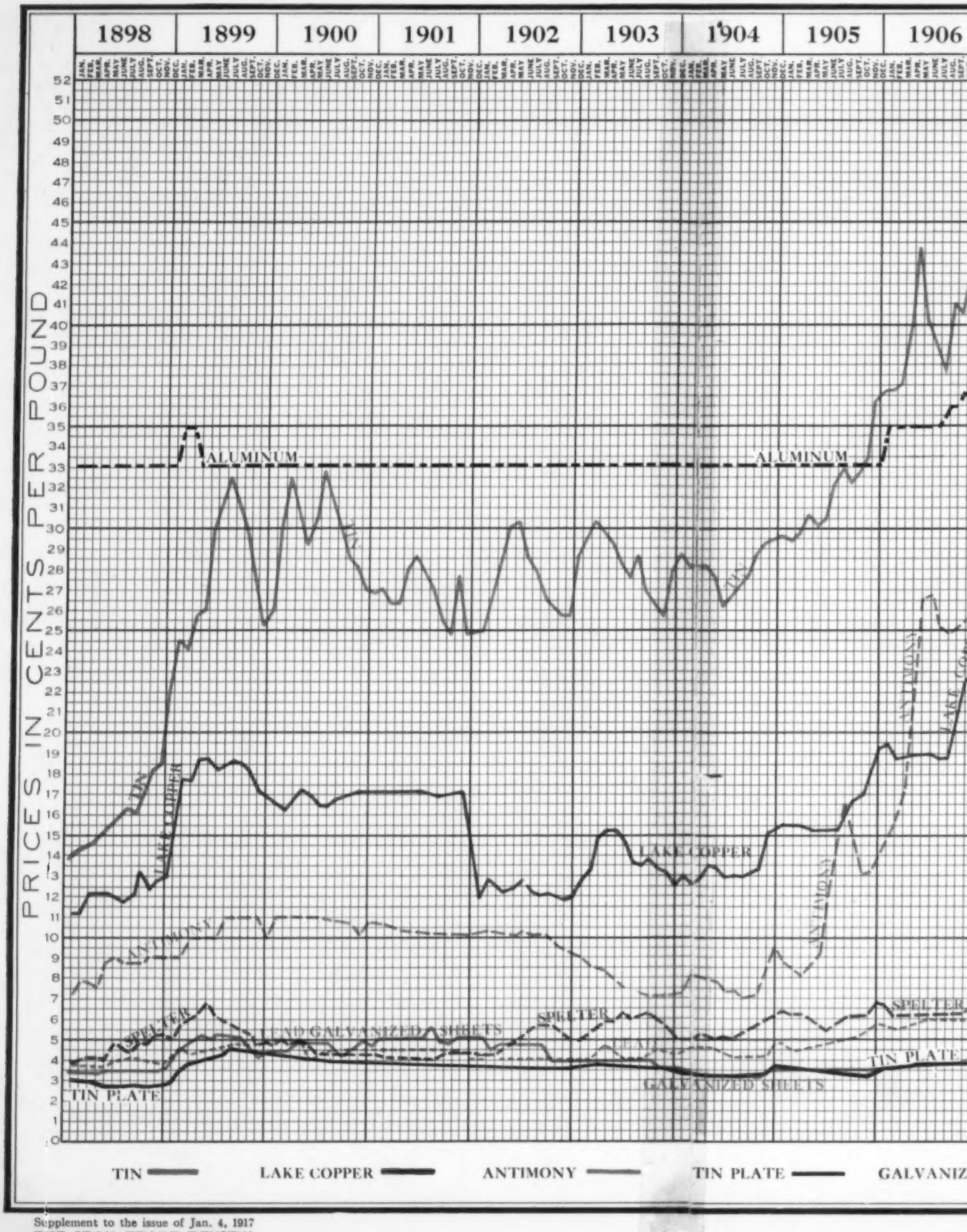
There can be no doubt but what better results in any attempt to round out the use of cars the year around will be obtained from the united effort of the roads, than from the well-meant but less effective endeavors of individual roads. That the railroads can work in harness when threatened by a common disaster has been shown by their united stand against the full crew laws, the Adamson bill, and similar legislation. The deplorable loss due to the variable demand for cars is no less a matter for concerted action than is the labor problem, and is one of the most flagrant examples of the general inefficiency of the present transportation system. The smooth working of the indidvidual lines is of small avail if the teamwork of the whole is below par.

This is No Time for Suspicion

The co-operative effort of the roads is useless unless it is backed up by the interstate commerce commission. Judging from past performances, it is not unlikely that an attempt on the part of the railroads to pool their cars for better service to shippers would be construed as an act concealing an ulterior motive detrimental to the public. In late years the too-suspicious attitude of federal commissions and legislators has not added to the harmony with which public utilities have worked to serve the people. First of all, the federal controlers of the railways should realize that the carriers must be placed on a financial footing so that they may purchase material at opportune times. The delay in placing orders for car

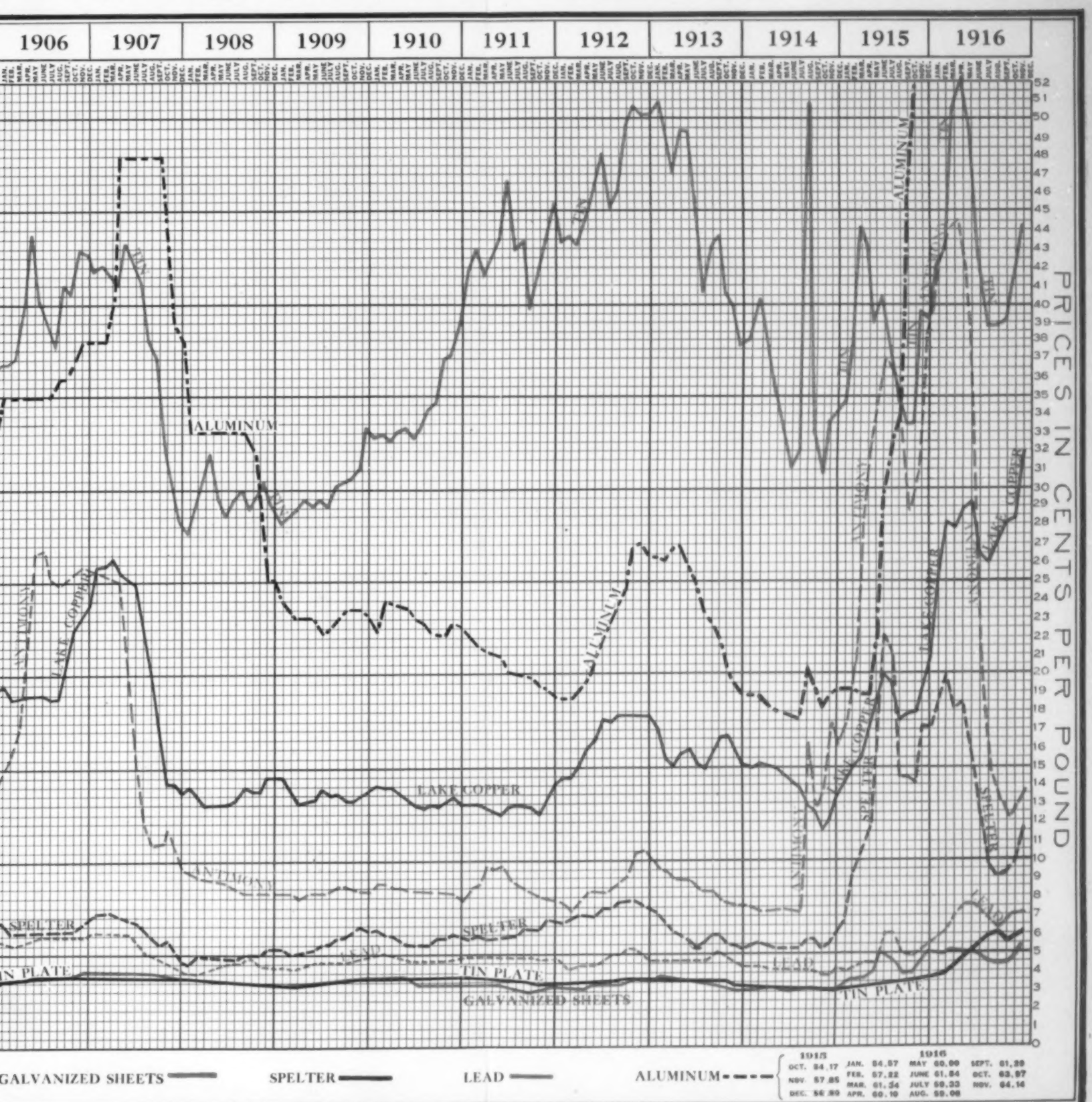
THE IRON T

Chart showing fluctuations in prices of pig tin, aluminum, antim



N TRADE REVIEW

, antimony, lake copper, spelter, lead, tin plate and galvanized sheets, 1898-1916



equipment until the past few months has not only added to the difficulties of the railroads, but has imposed an extra burden on the steel mills which are already flooded with business. The buying of equipment should be negotiated regularly.

Without going into the question of federal regulation at any great length, it can be said that a more liberal federal policy toward the transportation lines of the country is essential to the prevention of traffic congestion and car shortage. Public opinion will soon demand that railroads be treated fairly. Already, the representative newspapers of the country are making a plea for justice for the carriers. The *New York Times*, a paper that has been broad-minded in its treatment of railway controversies, has repeatedly shifted the blame for the present situation from the roads to the federal control and to the shippers. The *Chicago Tribune*, in an editorial entitled "Anybody Can Kick a Railroad" sums up the situation as follows:

"Political wiseacres are declaring that the law enlarging the interstate commerce commission will meet great opposition even from the present congress. Progressive politicians, according to newspaper articles, are afraid the president will appoint men 'favorable to the railroad'.

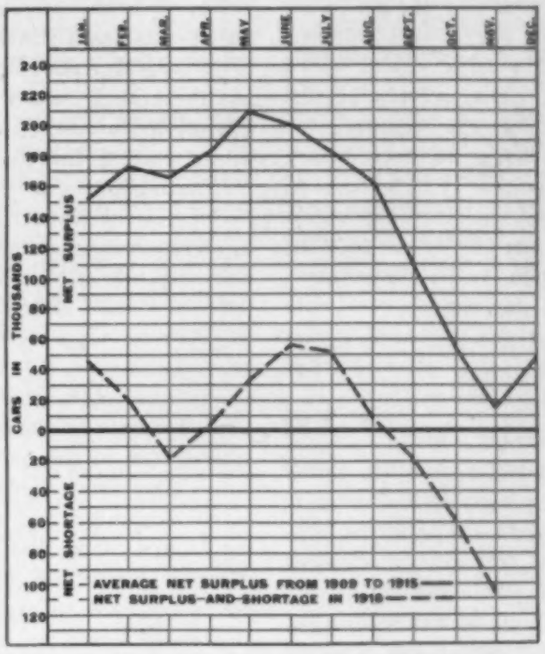
"It would be a frightful thing (or would it?) to have men on the commission who could see things from the side of the railroads. The railroads might be able to rehabilitate themselves; they might dare to invest in more freight cars; they might even extend their lines or put in double tracks if such a thing should come to pass. . . . . "

The *Railway Age Gazette*, which is closer to the railroad situation than any other publication, sums up the problem of judicial regulation as follows:

"What is the essential vice in the policy of regulation, which causes it to contribute toward the development of such conditions? Simply this: It so controls the rates of the railways that most of them do not in fat years earn enough money to tide them over the lean years. Consequently, in the lean years their expenditures for maintenance, and for improvements and increases of facilities, are restricted to the utmost in order to keep them out of bankruptcy, and they cannot in the fat years make large enough expenditures for maintenance and large enough investments in improvements to offset the heavy retrenchments made in the lean years. A policy which does not recognize the fact, as our policy of railway regulation does not, that every industry has to go through bad as well as good years, but which on the contrary is predicted on the assumption that rates which are hardly sufficient for prosperous years will be sufficient at any time, is bound at frequent intervals to give rise to such conditions as those with which the country is now struggling."

The ultimate solution of the traffic problem lies in the hands of men at Washington. The investigation conducted by the Newlands committee should result in better government regulation. In the adoption of a plan that will do justice to the railroads, lies the only hope for the final deathblow to traffic embarrassment.

Immediate relief from the grip of the car famine must come from temporary expedients. Shippers, carriers and consumers alike, should make every effort to make the best use of the available facilities. Shippers can fulfill their part of the program by handling cars promptly. The roads can ease the situation by securing more service from each car, by better distribution, and by expediting the movement of equipment. They can also improve conditions by aiding shippers to use flat cars, low open-top cars and other types instead of coal cars, which are so badly needed.



AVERAGES DO NOT FORETELL THE FUTURE

The upper line represents the average surplus existing during the seven years prior to 1916. The broken line indicates the car situation in 1916

That the shippers can do much to release cars more promptly is shown by numerous reports from all parts of the United States and Canada showing that cars are being held for storage purposes. Coal cars are being used for convenient stands to peddle their contents at retail. Speculation has played a part in the unwarranted holding of cars. A remarkable example of this practice is the sale of a large number of cars of coal by one of the largest jobbers in Chicago at $2 a ton. It was purchased by another jobber who sold it the same day at $2.25 a ton. Three times in as many days it changed hands—still in the cars—at advanced prices. Finally, on the morning of the fourth day, the company which had originally sold the coal at $2 a ton bought it back at $3, an advance of 50 per cent. Practices of this kind are fatal to the maintenance of an adequate car supply.

The revenue received by the railroads for demurrage indicates the number of cars that have been withheld from service. At the demurrage rate of $1 existing in Canada, the $90,000 received in demurrage charges each month means that 90,000 cars are held up one day over the limit. The $9,000,000 paid annually in demurrage charges to roads in the United States indicates that 9,000,000 cars are held at least one day more than the free time allowed. This means that if shippers can reduce the time of holding these cars to the normal free time limit, more than 24,000 cars will be released for service on each day of the year.

The railroads have always claimed that increased demurrage rates would remedy the car situation. The interstate commerce commission has been deaf to their pleadings, and late in November the higher rates of demurrage proposed by the carriers were suspended until March 31, 1917. This means that no penalty other than that which now exists can be imposed on shippers who wish to keep cars for their own use longer than the free time. On April 1, when the ban on the increased rates is removed, the car shortage undoubtedly will have been replaced by the usual spring surplus, and a penalty will not be needed.

In California, under a demurrage rate of $3, 79 per cent of the cars handled in a four-month period were released in the 24 hours of free time. During the same four months, under the $1 and $2 rates of the national code, only 63 per cent of the cars handled in the rest of the country were released in 24 hours. Cars held more than three days over free time in California amounted to 0.17 per cent of the total number of cars handled; while in the rest of the United States, the percentage was 4.2. This indicates that the higher demurrage rates are effective. On

(*Concluded on page* 106)

Features of Trade's Greatest Year

Record Breaking in Mining and Shipping Ore and in All Kinds of Manufacturing—Prosperity Brings Its Profits, Also Its Troubles and Its Problems for the Future

THE marvelous story of the iron trade for the past year is told with all its interesting details in the reviews in this issue written by associate editors of *The Iron Trade Review*. From iron ore to scrap, it is indeed a tale to chain the attention and excite the imagination, for never before in its eventful history have the making and selling of iron and steel attained such magnitude and such prosperity.

In past years, it has been customary to review the various markets at the leading manufacturing and selling centers. This was natural in the old days, when there were only two or three such centers, and as the industry ceased to a large extent to be localized, the custom persisted. But in view of the developments in many parts of the country, we believe that it is eminently fitting to treat every industry from a national viewpoint. It is, of course, necessary in quoting prices and in recording events to refer to different districts, but so far as possible, a nation-wide view of every industry has been taken. We commend the innovation to our readers with confidence that it will be approved. The past year has been a great one and now is an opportune time to begin to think in not less than national units.

The Great Record of the Lakes

IN MAKING the unparalleled record in 1916, nature seemed to smile upon the industry, particularly in the mining and shipping of iron ore. Last spring, and, in fact, well into the summer, fear was entertained in well informed circles, that the tonnage of ore which it would be possible to ship would fall far short of requirements and it was confidently expected that the total shipments would not aggregate much over 50,000,000 tons, but everything was favorable throughout the season for a record-breaking movement. The very body of water seemed to be lifted to carry an unprecedented burden, for the water was high. Even the winds were kind and there was an almost entire absence of storms, and the truly remarkable work of vessels, docks and railroads, resulted in the movement of the great total of 64,734,198 tons by lake, with the probability that the all-rail shipments will amount to 1,750,000 tons, making total shipments nearly 66,500,000 tons. The part that the railroads played in this movement deserves high commendation.

Following the ore to the blast furnaces, one finds that the record of astonishing achievement was continued. Month after month, records were broken in production, until the total for the year has far exceeded the product of any preceding twelvemonth. In the upward movement of prices, pig iron lagged far behind finished materials for a number of months, but after the advances were fairly under way, they followed each other in quick succession until, at the very close of the year they were halted by the German peace proposal. As the year closed, buyers were slow to place orders and sellers were perfectly satisfied. It was recognized by all that prices had been advancing too rapidly and that it was eminently fitting to have a breathing spell.

Not since the possibility of establishing a new industry was demonstrated in a most impressive manner under the McKinley tariff law in the case of tin plate has there been such a striking demonstration of how a protected industry can be built up as has been furnished during the past year by the manufacture of ferro-manganese in the United States. After the declaration of war in Europe, the situation in regard to ferro-manganese in this country was positively alarming and in the year 1915 it was demonstrated that the United States must develop its own resources in order to escape serious embarrassment, for in that year the imports of ferro-manganese from England were little more than one-quarter of the tonnage needed by the United States, and, of course, it was entirely out of the question to obtain any of the precious alloy from Germany. Although in 1916 more ferro-manganese and spiegeleisen were consumed in the United States than ever before, the increase in the domestic production, under the protection due to war conditions, was so rapid that prices were held within reasonable limits and steel manufacturers rested with the assurance that there was no danger of a shortage. As had been predicted in these columns, the claims that immense quantities of manganese ore would be produced by the Cuyuna range proved groundless and manufacturers of ferro-manganese in this country depended almost entirely on the importation of foreign ore, a very large part of which came from Brazil. Attempts to develop manganese ore deposits in different parts of the United States, as well as on the Cuyuna range, were disappointing.

Tremendous Demand for Shell Steel

ALTHOUGH the foreign demand manifested itself in nearly all kinds of iron and steel products, it was most prominent in the semi-finished market, in which from 4,000,000 to 5,000,000 tons of steel were purchased, principally by representatives of France and England, although a considerable tonnage was taken by companies in the United States engaged in the manufacture of shells. As the three buying movements of

the year proceeded, prices gradually ascended until very high figures were reached. The extremely heavy demand from abroad restrained the domestic market severely and not only users of sheet bars, but also of all other forms of semi-finished materials were compelled to pay high prices, although the contract prices have been much below the quotations for prompt delivery.

Finished Materials

IN THE finished material markets, plates command first attention. The demand for this material for the manufacture of ships and cars has been tremendous and continuous and prices mounted to new high levels. The published quotations in the central west follow closely those made for delivery at the convenience of the mills and do not ascend to those in eastern territory. It is nevertheless true that on a very large percentage of the tonnage sold by independent companies in the Pittsburgh and Cleveland, and perhaps other districts in the central west, for fairly prompt delivery, very high prices were obtained.

Other features of the finished material market were: Tremendous demand for sheets with many price irregularities; failure of production of structural material to keep pace with that of other finished products, owing to use of mills in making large rounds for export; heavy domestic demand for iron and steel pipe; exporting of large tonnages of barbed wire and frequent advances in prices of wire products; opening of books for tin plate for the first half of 1917 at $5.75, the highest at which any season ever opened.

New Record in Rail Buying

THE buying of rails last year was greater than that of any other year in the history of the trade,as the railroads came into the market not only to piece out their requirements for the year, but also to place large orders for 1917 and 1918 deliveries. Under the extraordinary demand, prices were twice advanced $5 per ton, but even after the second advance, making open hearth rails $40 and bessemer $38 per ton, quotations are much below those for other finished materials. The buying by foreign countries, particularly Russia, was a very prominent feature throughout the year and it is understood that the Czar's government is still anxious to place very large tonnages.

Troubles of the Cokemakers

IN BOTH prices and production, coke made a remarkable record. Extremely high quotations prevailed throughout December for prompt delivery, on account of the shortage of labor and cars. The labor situation has indeed been serious at times. Much difficulty was experienced in keeping the coke laborers at work, and some coke companies paid a bonus every two weeks or every month for regular work. The scale of wages has been high and many miners and workers at coke plants had no ambition to earn as much as they could have done with ease, but preferred to celebrate numerous holidays and absent themselves on other days from their work.

Financially Fortified

AMERICA'S greatest industry closes the year immeasurably stronger than ever before, not merely because all records of production and profits have been broken, but because it has conserved its earnings. There has been no reckless distribution of dividends. Bonds and other forms of indebtedness have been paid off and the companies have so fortified themselves financially that they will be much better able to resist any storms that may come in future years. Labor has shared generously in the earnings; compensation of employes of the Steel Corporation alone, as stated by Judge Gary, has been increased to the immense total of $33,000,000 during the year, and other forms of compensation and recognition, such as bonuses and insurance policies, have been adopted by many companies. While price advances have been rapid, there has been at no time a disposition to ask more than was justified under the law of supply and demand; in fact, frequently sellers have withdrawn from the market and have attempted in other ways to discourage runaway conditions. The extremely conservative price policy of the Steel Corporation has been continued and has exercised a highly beneficial influence.

Vital Questions

WHAT of the future? As one tries to read it, he sees the millions of graves of those who have fallen in the world's greatest war; he sees the army of cripples and realizes that there will be perhaps even more weakened by sickness for life's struggle; he sees the mountains of debt under which all of the belligerent nations must labor. At the same time, he realizes that this war has taught highly important lessons in organization, and that it has implanted in the fighting nations grim determination to maintain their places in the world's commerce. Even after years of suffering and privation, the people will be ready to make greater sacrifices to help their countries succeed in the commercial struggle of post bellum days. Giving weight to all considerations, no wise man will dare predict how successful a fight each nation will be able to make or how strong the competition will be with the United States.

Post Bellum Policies

WHAT position will this country take after the war? It will, of course, protect itself, but it will not forget that it is a member of the family of nations, and will not adopt a course that will make it the most hated nation on earth. It will try first, through the new tariff commission and in every other way possible, to ascertain the facts and do it in a thoroughly scientific manner. Then, let us hope, it will adopt a policy worthy of a nation which has prospered so abundantly.

Pig Iron Advance Slow in Coming

But Prices Ascend Rapidly After the Upward Movement Starts—Strong Demand from Foreign Countries—Talk of Peace Checks Buying But Prices Continue Firm to the End of the Year

BY C. F. WILLIAMS

THE spectacular pig iron drive of 1916, which led optimistic trade observers in the east and central west to talk seriously about $50 iron, did not get under way until October. During the early part of December, 322 of the 420 blast furnaces of the country were in operation. Nearly all of the merchant furnaces on Jan. 1 of this year had enough tonnage on their books to enable them to operate at maximum capacity through the first half of the year; some blast furnace operators before the close of last year had disposed of almost their entire output for 1917. Were it not for the fact that heavy tonnages of iron were carried in stocks at the opening of 1916, an acute shortage would have developed before the end of the year, despite the record-breaking production of metal by merchant and steel works furnaces. These started out to establish new production records in January of 1916. In that month, more than 3,000,000 tons of coke and anthracite pig iron were made, as against about 1,500,000 tons in the corresponding period of 1915. In the first half of last year, more than 19,000,000 tons of coke and anthracite pig iron were produced as against about 12,000,000 tons in the first half of the preceding year.

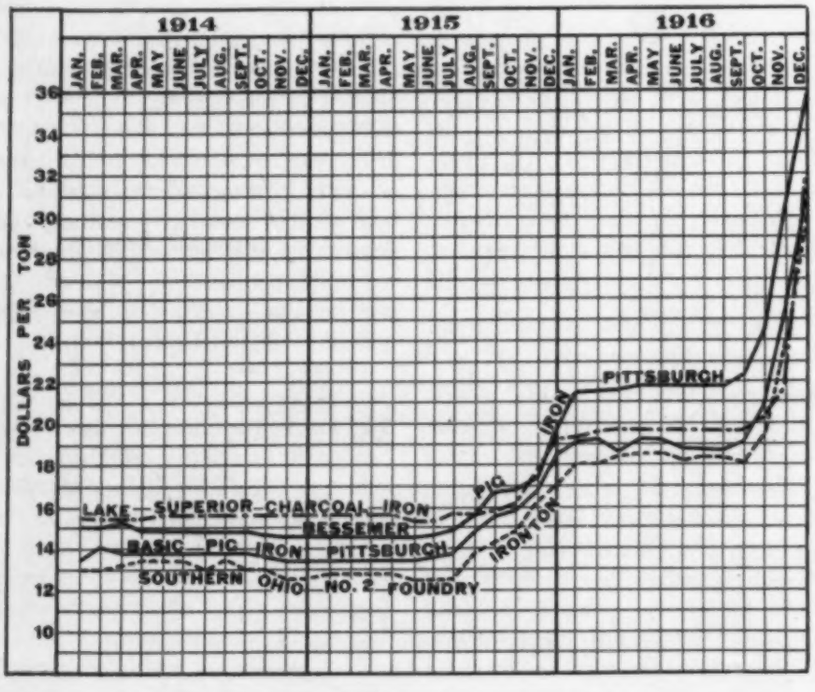
Although purchases of pig iron were extremely heavy, prices did not respond to the tremendous demand of melters until the latter part of the third quarter, after which time the upward movement of the market continued until the close of the year. The proposal, Dec. 12, of Germany and her allies to enter into peace negotiations with the nations at which they are at war, tended to check activity, but prices were not affected.

THE steady and insistent demand for all grades of pig iron was characterized by many rather unusual transactions. Representatives of the entente nations bought steelmaking irons in the east, the central west, the south and as far west as Chicago. Southern iron was shipped into the Pittsburgh, Buffalo, Cleveland and Chicago districts, and heavy tonnages of iron made in the Mahoning and Shenango valleys were sold to consumers in eastern Pennsylvania during the year.

Prices moved with puzzling obstinacy the first nine or 10 months. At times the market dragged to such an extent that declines ranging from 25 cents to $1 a ton resulted. In 1916, bessemer pig iron advanced $15 a ton in the valleys; basic pig iron registered advances of $12 a ton in the valleys; $12.50 in eastern Pennsylvania and $12 in southern Ohio; foundry iron advanced $12.50 in the valleys; $12 at Ironton and Cleveland; $11.50 at Chicago; $10.75 at Philadelphia; $17.50 at Buffalo; $11.50 at Birmingham and $10.75 in Virginia. Eight per cent silvery iron, offered at $25 at the opening of 1916, was selling at $36 a ton in December, or $11 a ton above the price 12 months previously. Low phosphorus pig iron in the central west and in the east advanced $23 a ton and Lake Superior charcoal iron registered an advance of $12.50 a ton during the year.

Blast furnaces in all sections of the United States were handicapped considerably in 1916, on account of the shortage and the slow movement of coke and coal. By-product coke plants in the east and central west frequently were unable to obtain tonnages of coal, on account of congested railroad traffic conditions, and many of them were thrown into the market for beehive oven fuel. Fires in many blast furnaces were banked for brief intervals, on account of deferred deliveries of coke.

Heavy export demand for iron was one of the unusually important factors of the year. Virtually all of the consumers of iron in the world were forced, by the readjustments caused by the European war, to turn to the United States for requirements. The largest foreign buyers last year were



PRICES OF FOUR GRADES OF PIG IRON, 1914-1916

the British Isles, France, Italy, Canada, Japan, Holland and the Scandinavian countries. The British government was a conspicuous buyer of Alabama basic iron, closing for two lots of 100,000 tons each. The purchase of the British and the French governments, most of which were made through J. P. Morgan & Co., aggregated not less than 400,000 to 500,000 tons, considerable of which yet is to be delivered. Total export shipments of pig iron in 1916 were approximately 600,000 tons, more than one-half of which came during the last four months. These exports were more than double those of the previous banner year, which was 1913, with 277,648 tons. Alabama and Tennessee furnaces furnished the larger portion of the iron ordered by foreign buyers, although northern, central western and western makers of bessemer and low phosphorus irons also supplied large tonnages. Most of the export iron was sold on along-side-the-ship basis, although there were some transactions calling for delivery at a foreign port.

The ocean freight rates on iron from the north Atlantic to European ports during most of the movement, ranged from $25 to $40 to the Mediterranean, $20 to $30 to French, $15 to $25 to British and $30 to $35 to Scandinavian ports.

Sharp Advances are Made in the Valleys

Owners of blast furnaces at Cleveland, Pittsburgh and in the Mahoning valley of eastern Ohio and the Shenango valley of western Pennsylvania did not enjoy record-breaking prices for pig iron until the third quarter of 1916. Prices of most pig irons, in the valleys, were almost stationary the first six months of the year. Bessemer pig iron, for instance, sold at $21 a ton in April, May, June, July, August and part of September. In January and March, this grade was quoted at $20 a ton, valley. During the last quarter, however, bessemer iron was well pegged at $35 a ton, valley furnace, and predictions have been made that this grade would sell at $50 a ton before the upward movement of prices comes to a halt. Basic pig iron in the valleys was quoted at $18.50 a ton early last January; after declining to $18 a ton the market advanced to $18.25 a ton in April, but again dropped to $18 in May, at which figure this grade sold until the latter part of September. Thirty dollars a ton was paid for basic iron the latter part of November, but the $18.50 price, first touched in April, was reestablished in July. A revival of activity was enjoyed in October and prices advanced from $18 to $20. Sellers were asking $30, Ironton, the latter part of the year for foundry irons.

Basic Demand Attracts Southern Sellers

Blast furnaces in the South entered the manufacture of basic iron in 1916 on a large scale, to meet the wide domestic and foreign demand. The trend of the market for southern and southern Ohio basic iron was similar to that of the market for foundry iron. It is interesting to note that more blast furnaces now are operating on basic than on foundry iron in southern Ohio.

Prices of Various Grades of Pig Iron for Three Years

BASIC, PITTSBURGH.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1914	$13.42	$14.09	$13.96	$13.90	$13.90	$13.90	$13.90	$13.90	$13.90	$13.75	$13.45	$13.45
1915	13.45	13.45	13.45	13.45	13.45	13.54	13.83	14.89	15.65	15.95	16.70	18.55
1916	19.20	18.77	19.20	19.20	18.95	18.95	18.95	18.95	19.08	20.83	25.95	30.95

BESSEMER, PITTSBURGH.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1914	$15.00	$15.09	$15.15	$14.90	$14.90	$14.90	$14.90	$14.90	$14.90	$14.85	$14.70	$14.70
1915	14.70	14.63	14.55	14.55	14.55	14.58	14.88	15.89	16.80	16.95	17.45	19.70
1916	21.32	21.45	21.55	21.95	21.95	21.95	21.95	21.95	22.20	24.33	30.35	35.95

NO. 2X FOUNDRY, PHILADELPHIA.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1914	$14.75	$15.00	$15.00	$15.00	$14.75	$14.75	$14.75	$14.75	$14.75	$14.50	$14.25	$14.25
1915	14.25	14.25	14.25	14.25	14.00	14.25	14.50	15.25	16.25	16.50	17.50	19.25
1916	19.75	20.00	20.00	20.75	20.50	19.75	19.75	19.75	19.75	20.50	25.25	30.00

SOUTHERN OHIO NO. 2 FOUNDRY, IRONTON.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1914	$13.00	$13.00	$13.25	$13.50	$13.50	$13.50	$13.00	$13.50	$13.00	$13.00	$12.63	$12.63
1915	12.75	12.75	12.75	12.75	12.56	12.50	12.60	13.63	14.20	14.88	16.13	17.00
1916	18.30	18.50	18.30	18.50	18.50	18.15	18.44	18.40	18.13	19.38	24.00	30.00

LAKE SUPERIOR CHARCOAL IRON, CHICAGO.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1914	$15.50	$15.50	$15.50	$15.50	$15.75	$15.75	$15.75	$15.75	$15.75	$15.75	$15.75	$15.75
1915	15.75	15.75	15.75	15.75	15.25	15.25	15.75	15.75	15.95	16.25	17.50	19.25
1916	19.25	19.50	19.75	19.75	19.75	19.75	19.75	19.75	19.75	20.35	21.95	31.75

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During the fourth quarter of 1915, nearly all of the larger foundry iron melters dependent upon southern Ohio stacks, covered their requirements for the first half of 1916. Southern Ohio No. 2 foundry was offered at $18 a ton for the first two months of 1916, but demand fell off to such an extent that several blast furnace interests in May reduced quotations to stimulate activity. Iron was offered freely at $18, Ironton, in June, but the $18.50 price, first touched in April, was reestablished in July. A revival of activity was enjoyed in October and prices advanced from $18 to $20. Sellers were asking $30, Ironton, the latter part of the year for foundry irons.

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The bulk of the southern foundry iron for distribution the first half of 1916 was sold the latter part of 1915. No. 2 foundry iron was quoted at $14.50, Birmingham, Jan. 1, 1916, and at $15 a ton in March, April and May. Quotations declined $1 a ton in June and another reduction of 50 cents a ton was made in August. Rather heavy tonnages were sold on the basis of $13.50, Birmingham, for shipment the second half of the year. That figure represents the extreme low point of the market in 1916. During the latter part of the year, prices advanced steadily. In November, quotations jumped from $17 to $21, Birmingham. Virtually all southern sellers had disposed of their entire output the first six months of 1917 before Dec. 1, last.

Southern Ohio silvery iron advanced $11 a ton in 1916. Eight per

cent material, quoted at $25, furnace, on Jan. 1, was sold at $36, furnace, the early part of December. The trend of the market for this grade was similar to that of southern Ohio No. 2 foundry iron. Several blast furnace stacks, which had figured in the market for silvery and foundry iron, produced basic iron the greater part of 1916.

Eastern Pig Iron Conditions

How narrow was the movement of the eastern market during the months of January to October, 1916, is shown by comparative quotations. Eastern Pennsylvania No. 2X began the year of 1916 at $19.75, at the furnace; on Oct. 1, it still was at $20. Eastern Pennsylvania basic on the corresponding dates was at $18.50 and $20, furnace, respectively; Virginia No. 2X at $17.25 and $17.50, furnace; Buffalo No. 2X at $17.50 and $19, furnace. Resale iron arising from the heavy speculative purchases of the preceding year overhung the market for a number of months, and was a drag on prices until it was absorbed. It was estimated that these speculative purchases of 1915 had aggregated 1,000,000 tons, a considerable portion of which was in districts tributary to the eastern market, such as Buffalo and Virginia.

Prices never before advanced as rapidly in the east as they did in October and November of 1916. Eastern Pennsylvania basic rose $10 per ton, to $30, furnace; eastern Pennsylvania No. 2X, $10 to $30, furnace; Virginia No. 2X, $8.50 to $10.50 to $26 to $28, furnace; Buffalo No. 2X, $11 to $12, to $30 to $31, furnace, and Buffalo basic, $11 to $30, furnace. The net advances of the year were about $10.25 in eastern Pennsylvania foundry; $11.50, in eastern Pennsylvania basic; $10 in Virginia and $13 in Buffalo.

The Bethlehem Steel Co. practically disappeared in the year as a seller of iron except of low phosphorus, from the Lebanon furnaces, acquired from the Pennsylvania Steel Co. Of interest in the Buffalo market were the several large purchases of hot metal by the Lackawanna Steel Co. from the Susquehanna furnaces, covering the last half of 1916 and subsequently all of 1917 and involving 250,000 to 300,000 tons of metal.

Chicago Boom Starts With a Rush in October

At the beginning of 1916, northern No. 2 foundry was quoted at $18.50, and malleable at $19, Chicago. These grades advanced $11 to $11.50 per ton in the year just ended. The opening quotation held without change until nearly the end of March, when an advance of 50 cents per ton was made. A decline of 50 cents was made in September. By the end of October, both grades of iron were selling at $20, furnace, and through November a further advance of $7 per ton was registered. During a portion of November, the advance was maintained steadily for several days at the rate of 50 cents per day. In that month, practically the entire make of all furnaces for the first half of 1917 was sold. Considerable buying for last half delivery in 1917 was done early in December. Lake Superior charcoal iron opened the year at $17.50, and the first week in December was being held at $30, furnace, for the cheaper grade.

The most important event in the pig iron situation in the west was the sale late in May of the Iroquois Iron Co. to a syndicate representing a number of important interests in and about Chicago.

Low phosphorus pig iron, under a heavy domestic and foreign demand which supplies were inadequate to meet, rose to record prices in the east and central west. Standard low phosphorus iron in January, 1916, was quoted at $32, Philadelphia. It advanced moderately until October, when its movement was very rapid. In December, domestic sales were made at $52 to $55, delivered eastern Pennsylvania, and export lots had gone at $55, eastern Pennsylvania furnace. Lebanon low phosphorus advanced about $20 in the year; it started at $29 and $31 and closed around $50, furnace. Low phosphorus iron at Pittsburgh was quoted at $30 to $31 in January, 1916; sales at $50 and $51 were made in December.

Record Year in Steel Pipe

Builders of oil and gas lines and consumers of standard pipe in various sections of the United States called upon manufacturers of tubular goods for tonnages of record-breaking proportions in the year of 1916. Pipemakers during the latter part of the year were unable to cope with the situation; they put up prices to the highest levels ever recorded in the history of the trade, and many mills before Dec. 1 actually withdrew from the market for delivery in the first half of 1917. Virtually all of the tonnage carried into this year by sellers of wrought pipe will be shipped to domestic consumers. Pipe mills were operating at not more than 75 per cent of theoretical capacity a year ago. Today every serviceable welding furnace in the country is being used to meet the insistent demand of consumers.

Attractive prices offered last year for gas and crude oil, induced owners of property in the oil and gas regions to further develop their interests. An order for 800 miles of steel line pipe, involving approximately 60,000 tons, was distributed about six months ago for a gas line to extend from the Oklahoma fields to Chicago. This is one of the largest single orders for welded material ever placed in this country. At least a dozen contracts, each calling for from 8,000

Changes in Prices of Steel Boiler Tubes Since Jan. 1, 1912

Date.	Sizes in inches.	Basing discount.
Jan. 15, 1912 to June 1, 1912	¼ to 5⅝	72½
June 1, 1912 to July 24, 1912	3½ to 4½	74
July 24, 1912 to Sep. 10, 1912	3½ to 4½	73
Sep. 10, 1912 to Jan. 1, 1913	3½ to 4½	72
Jan. 1, 1913 to Feb. 1, 1913	3½ to 4½	71
Feb. 1, 1913 to May 29, 1913	3½ to 4½	70
May 29, 1913 to Jan. 2, 1914	3½ to 4½	69
Jan. 2, 1914 to May 1, 1914	3½ to 4½	71
May 1, 1914 to Apr. 1, 1915	3½ to 4½	72
Apr. 1, 1915 to May 1, 1915	3½ to 4½	75
May 1, 1915 to June 1, 1915	3½ to 4½	74
June 1, 1915 to June 15, 1915	3½ to 4½	74
June 15, 1915 to July 16, 1915	3½ to 4½	73
July 16, 1915 to Oct. 1, 1915	3½ to 4½	72
Oct. 1, 1915 to Oct. 29, 1915	3½ to 4½	71
Oct. 29, 1915 to Dec. 1, 1915	3½ to 4½	69
Dec. 1, 1915 to Jan. 7, 1916	3½ to 4½	68
Jan. 7, 1916 to Jan. 20, 1916	3½ to 4½	66
Jan. 20, 1916 to Feb. 29, 1916	3½ to 4½	64
Feb. 29, 1916 to Mar. 15, 1916	3½ to 4½	62
Mar. 15, 1916 to Mar. 29, 1916	3½ to 4½	61
Mar. 29, 1916 to Apr. 15, 1916	3½ to 4½	60
Apr. 15, 1916 to Sept. 7, 1916	3½ to 4½	56
Sept. 7, 1916 to Nov. 1, 1916	3½ to 4½	54
Nov. 1, 1916 to Nov. 20, 1916	3½ to 4½	52
Nov. 20, 1916	3½ to 4½	46

to 20,000 tons, were placed in 1916. The Jones & Laughlin Steel Co., which entered the manufacture of steel pipe last year, virtually had withdrawn from the market before its four furnaces were put into operation. This concern, like other makers of welded material, was called upon to furnish heavy tonnages of line pipe.

The more popular sizes of iron and steel pipe were changed in price 12 times between Jan. 1 and Dec. 4, 1916; these changes are given in an accompanying table, based upon discounts for standard steel pipe. Price changes made by wrought iron pipe manufacturers were identical with those announced by steel pipemakers. Black butt welded iron and steel pipe was advanced about $4 a ton in 1915; last year it was put up $22 a ton. Galvanized butt welded standard pipe last year registered a total advance in price of $20 a ton, as against an advance of $12 a ton in 1915. Iron and steel boiler tubes in 1916 advanced $42 a ton; the upward movement in 1915, generally regarded as an unusually satisfactory year, amounted to $15 a ton.

Locomotive and merchant boiler tube demand reached such proportions early last year that manufacturers easily gained and maintained control of the market. Many sellers, taking advantage of attractive trade conditions, disposed of their material at several dollars a ton above the generally prevailing prices. The National Tube Co. advanced prices of boiler tubes nine times during the year, amounting to $42 a ton. Advances of $4 a ton each were made on Jan. 7 and 20, March 15, Sept. 7 and Nov. 1; advances of $2 a ton were made on Feb. 29 and March 29; of $8 a ton on April 15, and of $10 a ton on Nov. 20.

Several seamless tube mills have been figuring in the market for munitions and war equipment since shortly after the European struggle began. Domestic demand last year was heavier than in any previous period in the history of this branch. One of the leading manufacturers of seamless tubing now has enough actual orders on its books to maintain present operating rates well into 1918.

Changes in Prices of Standard Steel Pipe Since Jan. 1, 1910

Date.	Sizes in inches.	Butt Weld Basing Discount Black.	Galv.
Jan. 1, 1910 to Oct. 1, 1910	½ to 6	78	68
Oct. 1, 1910 to Oct. 2, 1911	2 to 3	80	70
Oct. 2, 1911 to Dec. 1, 1911	2 to 3	81	74
Dec. 1, 1911 to Dec. 15, 1911	2 to 3	83	76
Dec. 15, 1911 to Jan. 1, 1912	2 to 3	83	76
Jan. 1, 1912 to July 1, 1912	2 to 3	82	75
July 1, 1912 to July 24, 1912	2 to 3	82	75
July 24, 1912 to Sep. 10, 1912	2 to 3	81	74
Sep. 10, 1912 to Jan. 1, 1913	2 to 3	80	72
Jan. 1, 1913 to Apr. 12, 1913	½ to 3	80	71½
Apr. 12, 1913 to May 27, 1913	½ to 3	79½	71
May 27, 1913 to Aug. 8, 1913	½ to 3	79	70½
Aug. 8, 1913 to Oct. 27, 1913	½ to 3	80	71½
Oct. 27, 1913 to Feb. 2, 1914	½ to 3	80	71½
Feb. 2, 1914 to Apr. 20, 1914	½ to 3	79½	71
Apr. 20, 1914 to Nov. 2, 1914	½ to 3	80	71½
Nov. 2, 1914 to Feb. 11, 1915	½ to 3	82	72½
Feb. 11, 1915 to May 1, 1915	½ to 3	80	69½
May 1, 1915 to June 1, 1915	½ to 3	79	68½
June 1, 1915 to June 17, 1915	½ to 3	79	63½
June 17, 1915 to Aug. 15, 1915	½ to 3	79	57½
Aug. 15, 1915 to Nov. 1, 1915	½ to 3	79	63½
Nov. 1, 1915 to Jan. 4, 1916	½ to 3	78	63½
Jan. 4, 1916 to Jan. 20, 1916	½ to 3	77	62½
Jan. 20, 1916 to Feb. 15, 1916	½ to 3	76	60½
Feb. 15, 1916 to Feb. 29, 1916	½ to 3	75	59½
Feb. 29, 1916 to Mar. 15, 1916	½ to 3	74	57½
Mar. 15, 1916 to Mar. 29, 1916	½ to 3	73	55½
Mar. 29, 1916 to Apr. 21, 1916	½ to 3	72	53½
Apr. 21, 1916 to July 24, 1916	½ to 3	70	50½
July 24, 1916 to Sept. 7, 1916	½ to 3	70	55½
Sept. 7, 1916 to Nov. 1, 1916	½ to 3	69	55½
Nov. 1, 1916 to Nov. 15, 1916	½ to 3	69	55½
Nov. 15, 1916 to Dec. 4, 1916	½ to 3	66	52½

Cast Iron Pipe in 1916

Cast iron pipe has found 1916 a profitable period from the standpoint of business and prices. Being based directly on the price of pig iron, cast iron pipe prices have followed much the same course as its raw material. At the beginning of the year 6-inch, class B pipe was quoted at about $26 per ton at eastern foundries and $28.50, delivered, Chicago. Three advances of $1 each were made in the first nine months, as pig iron began to forge ahead. During October and November, heavy advances were made, $3 to $5 per ton being added at a single boost. In mid-December, the price delivered in Chicago was $41, while at New York the delivered price was $41.50.

During the first half of the year, business was not in large volume for domestic use. Cities, always heavy buyers, restricted their requirements in face of what appeared then as high prices. Later, business increased in volume and all shops took on comparatively heavy tonnages. Much of this business came in the form of specials for industrial work, an unusual demand from this source increasing the total of sales materially.

At the close of the year, order books were well filled and in view of future costs rising rapidly, makers were taking business with caution. Cities making up their schedules of requirements and appropriations for 1917 found prices much higher than at the earlier portion of the year, and again have attempted to postpone extensions not absolutely necessary, This action provides a large latent demand which will come out in future when prices become easier and promises continued business in the next few years.

A notable feature of the market in this product in which southern and eastern shops shared largest has been the extensive inquiry for American pipe for export, particularly from South American countries. Some large contracts resulted, the most important being an order for 60,000 tons for Buenos Aires, Argentina, which was taken by the United States Cast Iron Pipe & Foundry Co. The heavy annual demand from this growing city had been supplied for many years by British and German shops. New work in that city has demanded a large tonnage each year and will continue to do so for many years. A contract for 10,000 to 12,000 tons for Uruguay was another important sale. These contracts demonstrate the good results of excellent team work of American banking and industrial interests. A considerable tonnage was sold to Cuba during the year. The export business would have been larger had sufficient shipping facilities been available. Resulting high freight rates also served to restrict this business.

The H. C. Frick Coke Co., a subsidiary of the United States Steel Corporation, on Dec. 16, advanced wages of its employes 10 per cent. Independent operators in the Connellsville regions have granted similar increases in pay to their employes.

American Skill Solves Problem

By Greatly Increasing Production of Ferro-Manganese and Spiegeleisen and Establishing a Highly Important Industry—Extraordinary Prices Paid for Prompt Delivery

HOW American manufacturing skill and adaptability met and solved a situation, without which the year's surpassing record in steel production could not have been established, is the story of the market in ferro-manganese and spiegeleisen of 1916. In many respects the year was the most remarkable in the history of the production or consumption in this country of these manganese alloys. Until the extraordinary necessities of the steel industry, which by far were the greatest ever known, could be met by increased home production, reduced imports from England due to the restrictions of the British government, created a famine condition in ferro-manganese and led to extraordinary prices. Spot metal on these occasions sold at $450, seaboard, and there were reports which could not be verified that much higher had been paid. Spiegeleisen experienced a corresponding condition. American furnace managers by the large volume and high quality of the metals produced, signally demonstrated their ability to turn out an alloy equal to the best foreign brands. Apparently they have been able to establish a new domestic merchant industry on a permanent commercial basis which will make the American steel industry less dependent upon foreign supplies in the future. This is the big and important contribution of the year's developments.

The United States in 1916 consumed by far more ferro-manganese and spiegeleisen than ever before in its history. The amount of this was approximately 365,000 tons of ferro-manganese and 170,000 tons of spiegeleisen, this representing the actual domestic production and the imports. The production of ferro-manganese by domestic furnaces, according to the statistics collected by *The Iron Trade Review* was approximately 270,000 tons and of spiegeleisen about 170,000 tons. Imports of ferro-manganese were about 95,000 tons. Those of spiegeleisen were negligible.

THE country never before had produced ferro-manganese so extensively as in 1916. The experience of the previous year had shown that England, under war conditions, could not be relied upon to furnish its normal proportion of the country's requirements. In 1915, the imports of ferro-manganese from England had been only about 28 per cent of the estimated total consumption of the United States. In 1916, it is computed from the statistics available that they were only about 25 per cent. This compares with 44 to 60 per cent during the several years immediately preceding the war. The actual proportion that English ferro-manganese in 1916 bore to the country's total consumption of high manganese alloys, however, was even less than that shown, because the exigencies of the times forced the larger use of spiegeleisen by many consumers as a supplement to or substitute for ferro-manganese, and all of this came from domestic furnaces. The home output of spiegeleisen in 1916 was about 180,000 tons, compared with 114,000 tons in 1915. The production of spiegeleisen in 1916 was the largest since 1907, when the bessemer process was at its height. In that year, 283,000 tons were made. At least a dozen furnaces were producers of ferro-manganese or spiegelensen, either for the use of the companies which operated them or for the market. The furnaces thus engaged were the two Dunbar, Pa., furnaces, two Palmerton, Pa., one Cornwall, Pa., one Iroquois at Chicago, Sheridan, Pa., Marshall at Newport, Pa., Meily at Lebanon, Pa., and steel works furnaces at South Chicago, Ensley, Pittsburgh, Sparrows Point, Pueblo and elsewhere. The Kittanning, Pa., stack, made a run on ferro-manganese for the Jones & Laughlin Steel Co. Some tonnage was made by the electrolytic process at Heroult, Cal. At the close of the year, one of the Tonawanda furnaces at Buffalo was put in readiness to make ferro-manganese. Some of the steel works makers at times were sellers in the open market. In addition to producing about 75 per cent of its own needs of manganese alloys, the country exported a fair quantity of both ferro-manganese and spiegeleisen. Canada was a buyer on repeated occasions, as were Italy, Sweden, Holland, Australia and other countries. A limited tonnage of Indian ferro-manganese containing 70 to 75 per cent manganese, was marketed and imported during the year. This was sold on a unit basis.

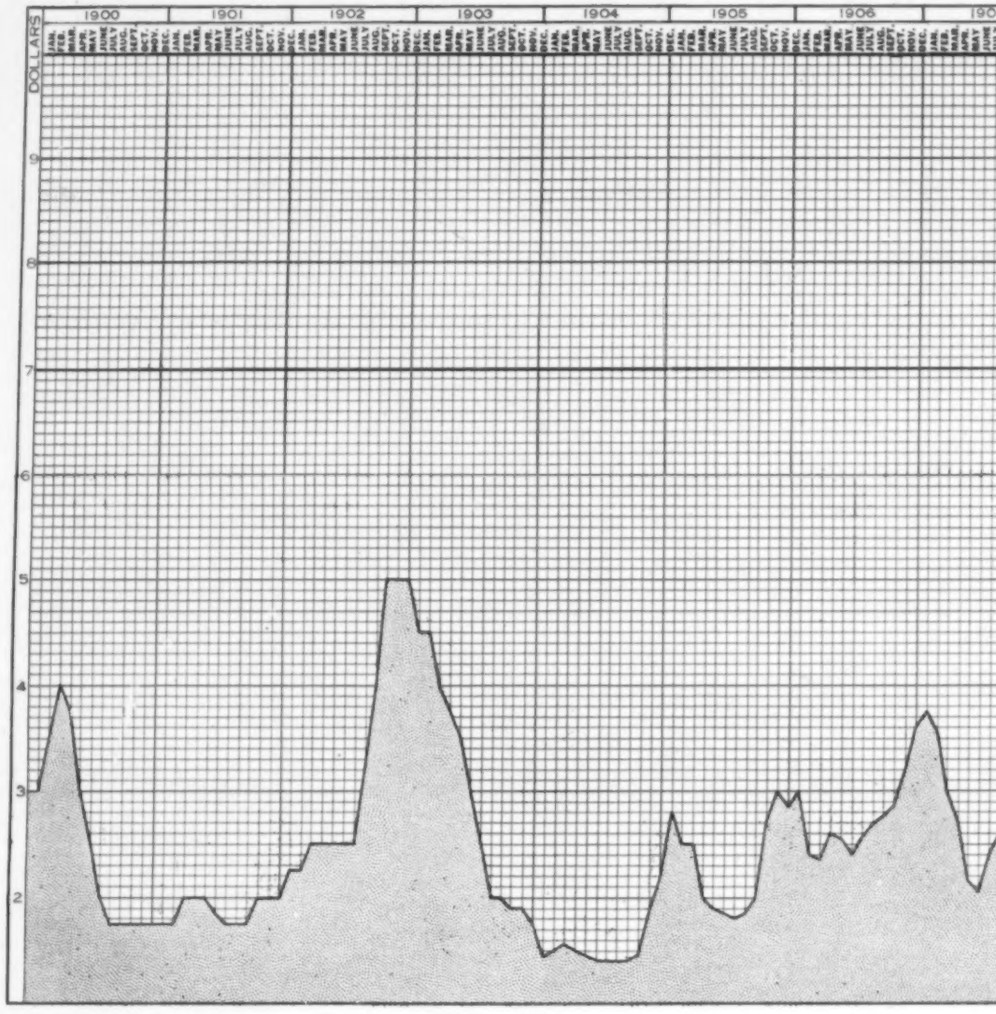
When the steel industry unlimbered itself during the last quarter of 1915 and started on a career of production that far surpassed anything of the past, the drain on the supplies of ferro-manganese and spiegeleisen soon showed its effect. Shipments of ferro-manganese from England were on a limited scale which permitted of no appreciable increase under the circumstances. During the first three months of 1916, they averaged only about 6,600 tons monthly. Domestic merchant production had not yet become important. Steelmakers saw their stocks undergoing an alarming diminution and unable to make new purchases abroad for early delivery, they began to search about for spot metal. As steel production continued to rise rapidly and consumption of ferro-manganese and spiegeleisen to increase accordingly, a famine condition quickly arose. Some steelmakers faced

Imports and Domestic Production of Manganese Alloys: Imports of Ore

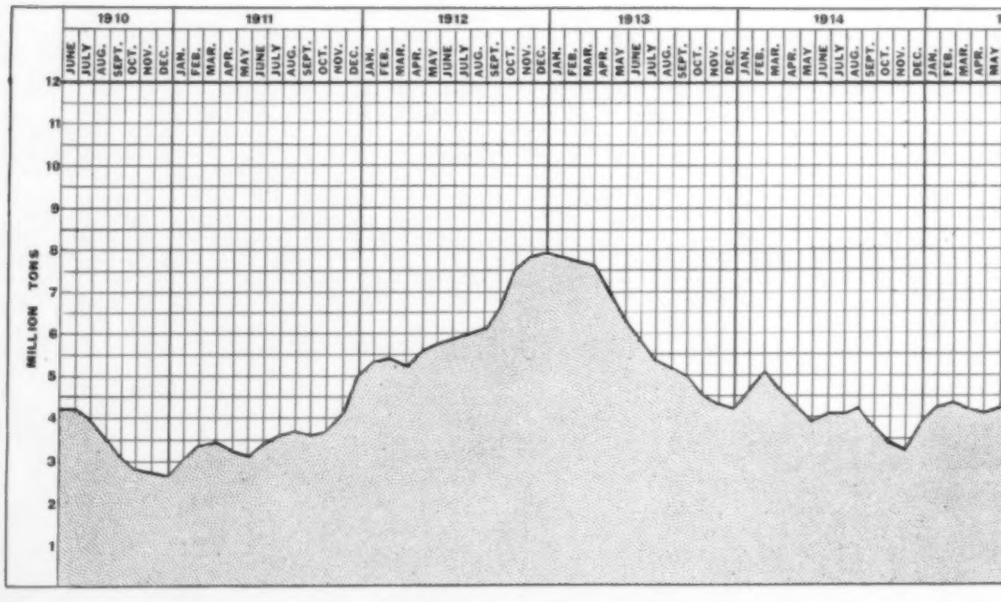
	Production		Imports		Imports
	Ferro-Manganese	Spiegeleisen	Ferro-Manganese	Spiegeleisen	Manganese Ore
1916.....	270,000*	170,000*	95,000*	.....	575,000*
1915.....	144,260	114,556	55,263	200	313,985
1914.....	100,731	76,625	82,997	2,870	283,294
1913.....	119,495	106,980	128,070	77	345,090
1912.....	125,378	102,561	99,137	1,015	300,661
1911.....	74,602	104,013	80,263	20,970	176,852
1910.....	71,376	153,055	114,228	25,383	242,348
1909.....	82,209	142,831	88,934	16,921	212,765
1908.....	40,642	111,376	44,624	4,579	178,203
1907.....	55,918	283,430	87,406	48,994	209,021
1906.....	55,520	244,980	84,359	103,268	221,260
1905.....	62,186	227,797	52,841	55,457	257,033

*Estimated.

Charts showing prices of prompt furnace coke, producti



PRICES AT OVENS OF CONNELL

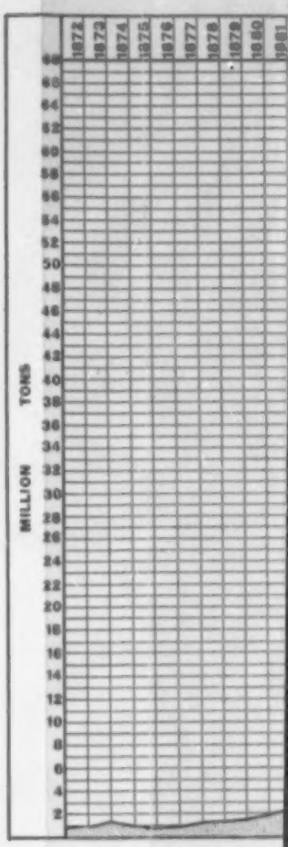


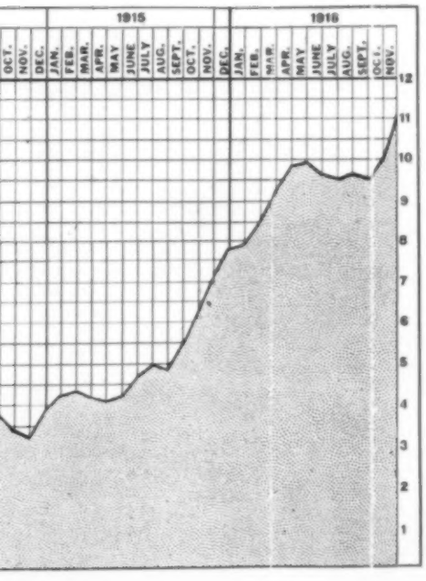
UNFILLED TONNAGE, UNITED STATES STEEL CORPORATION, 1910-1916

THE IRON TRADE REVIEW

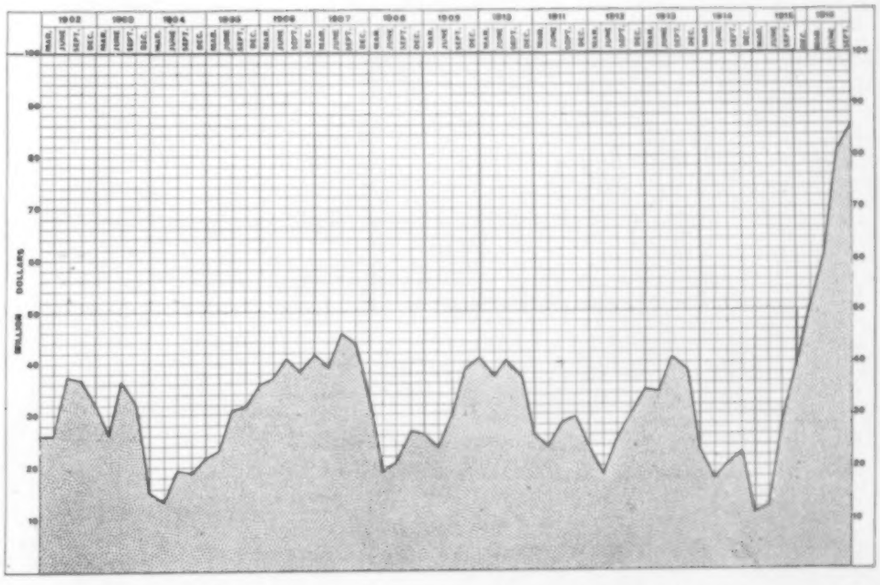
roduction of pig iron, unfilled tonnage United States Steel Corporation, net earnings United States Steel

OF CONNELLSVILLE FURNACE COKE, PROMPT DELIVERY, 1900-1916

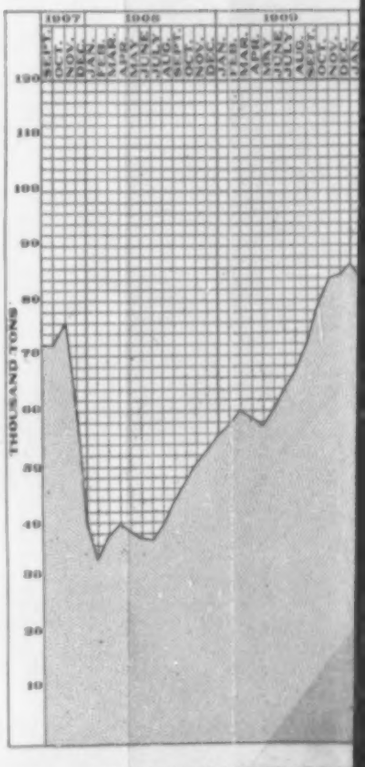




ON, 1910-1916



NET EARNINGS, UNITED STATES STEEL CORPORATION, 1902-1916



DAILY AVERAGE PRODUCT

THE IRON TRADE REVIEW

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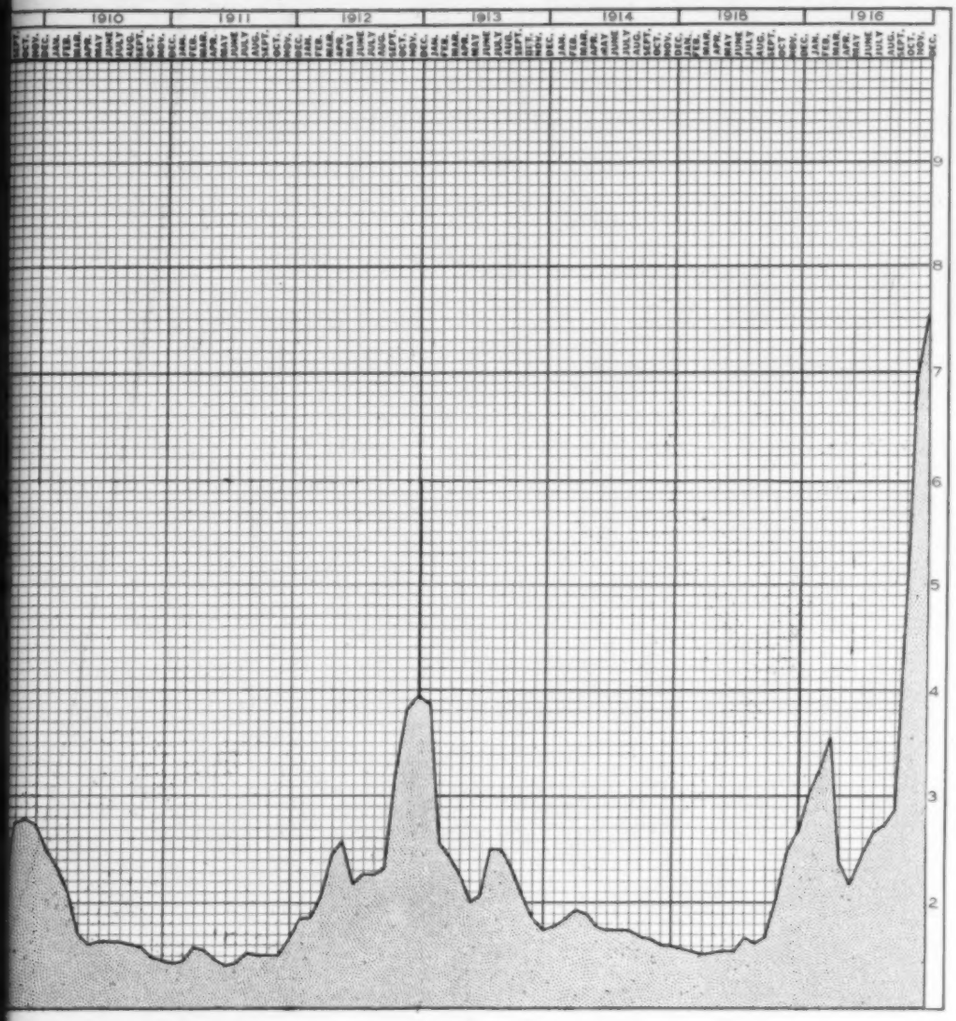
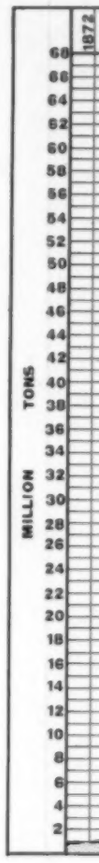
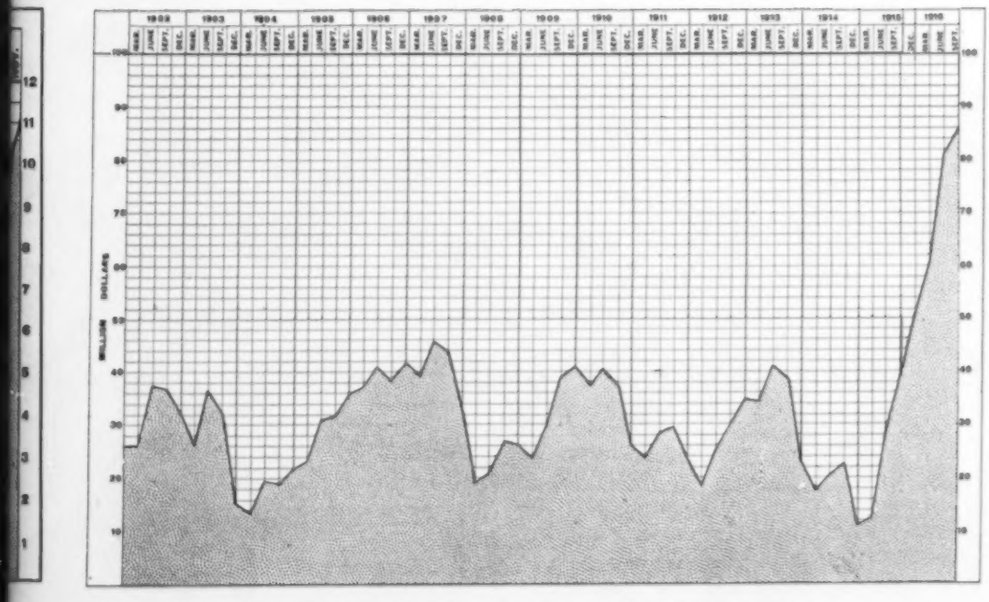
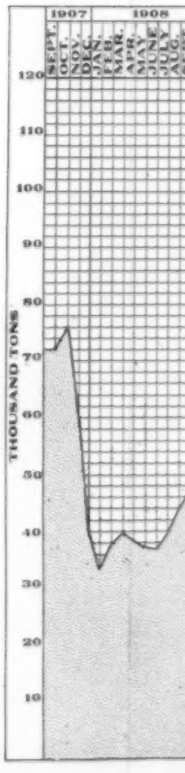




MPT DELIVERY, 1900-1916



NET EARNINGS, UNITED STATES STEEL CORPORATION, 1902-1916



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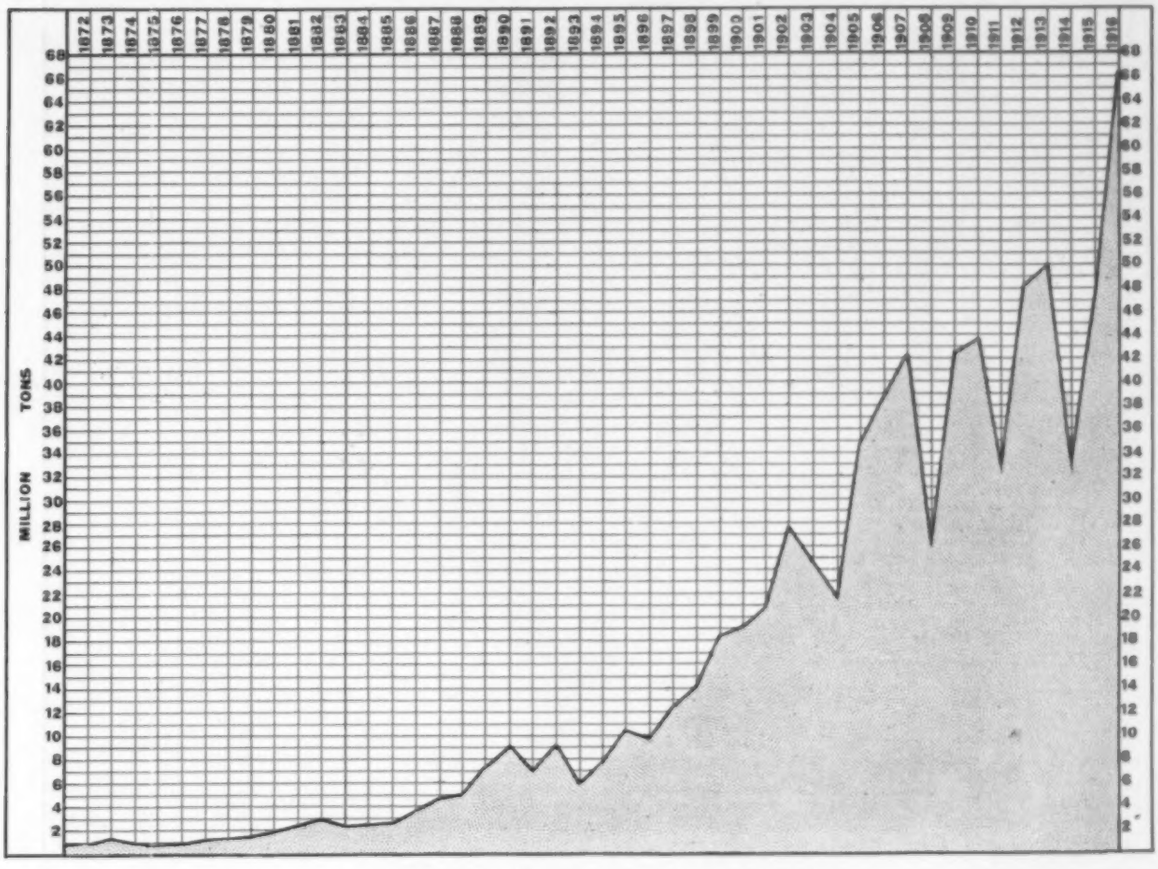
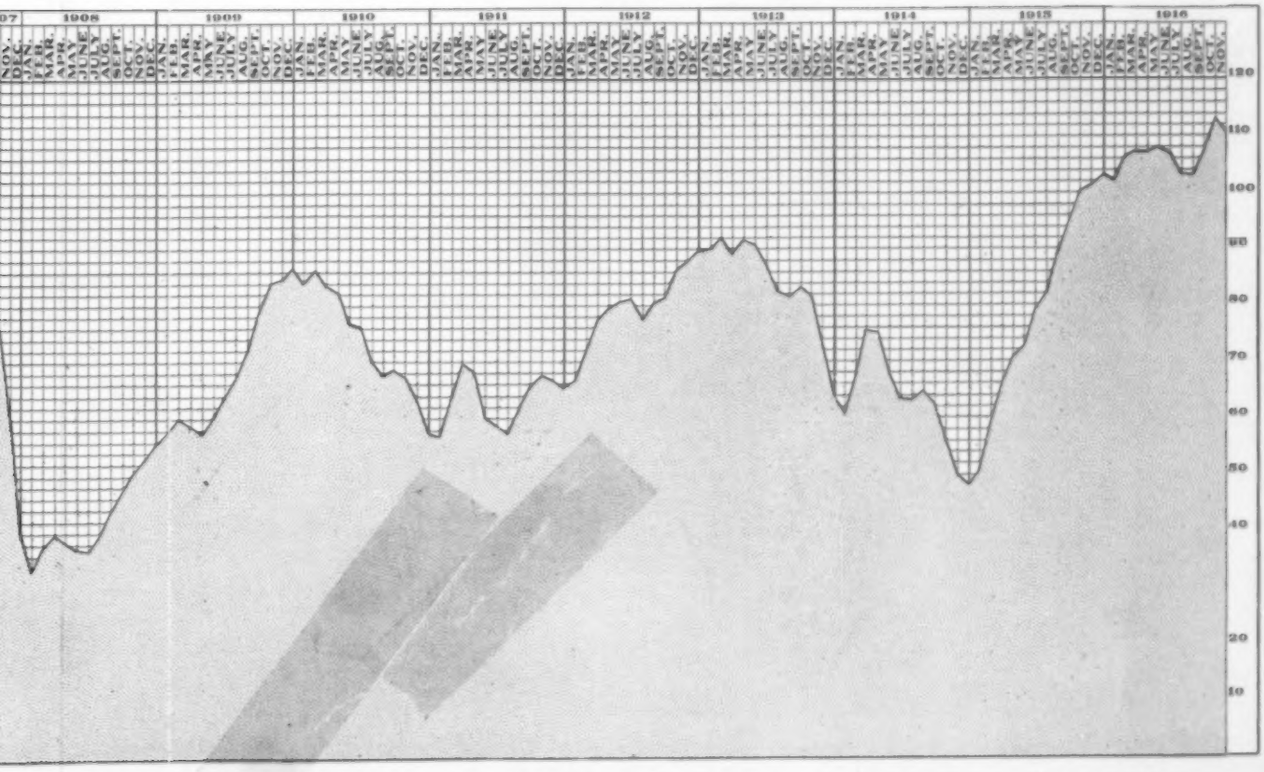
United States Steel Corporation and shipments of Lake Superior iron ore.



SHIPMENTS, LAKE SUPERIOR IRON ORE, 1872-1916



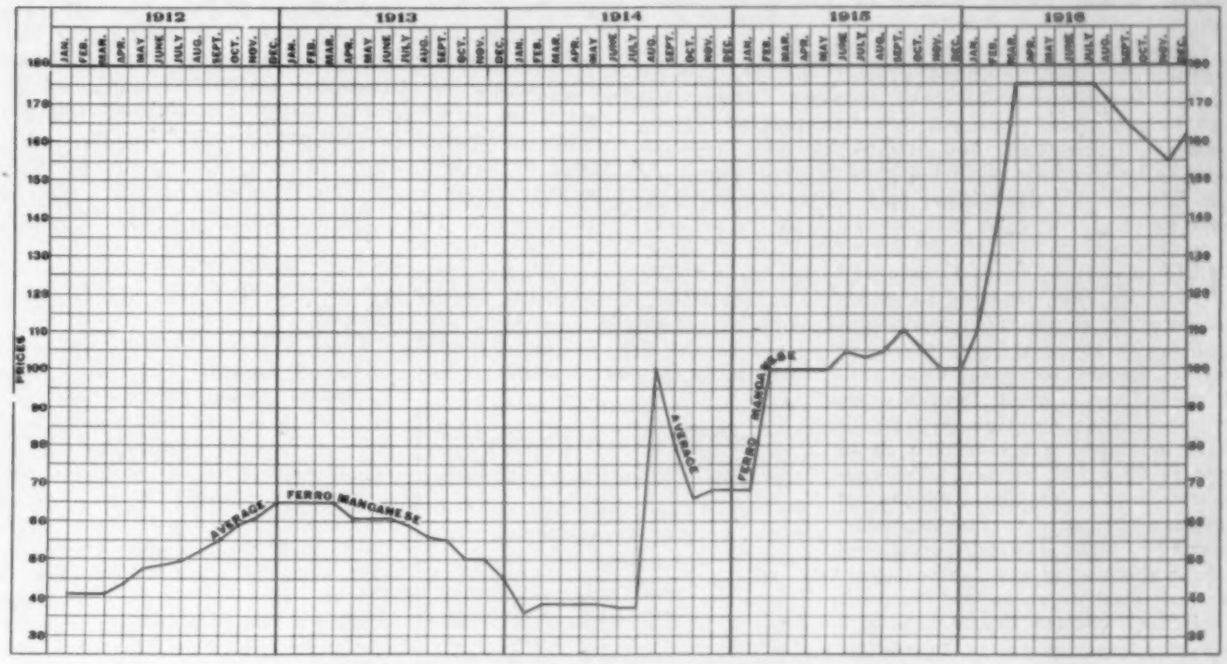
DAILY AVERAGE PRODUCTION COKE AND ANTHRACITE PIG IRON IN THE UNITED STATES, SEPT., 1907, TO DEC. 1, 1916

the extremity of shut-downs and were helped out by better-supplied competitors. Starting at $150, in January, spot prices were bid up to unprecedented heights until in March and April, $400 to $450, seaboard, became the ruling figures. This, by a wide margin, was the highest price level ever reached by ferro-manganese in this or probably any other country, completely eclipsing those prevailing during the Russo-Japanese war. Spot spiegeleisen ran a parallel course with ferro-manganese and commanded up to $100, furnace, during April. The increasing weight of the domestic merchant production then began to have its effect and the strin-cents in May. In June, Indian and Cuban ores were sold at 70 and 75 cents. The last price for Cuban ore was the highest ever paid. In October, there were sales of Indian ore at 65 cents. Offerings then became limited, owing chiefly to shipping conditions, and in December quotations of about 78 cents were made. Brazilian ore then was held around 70 cents and was scarce. The Steel Corporation was a further large buyer of Brazilian ore during the year and under a transaction announced early in October took about 200,000 tons at 44 cents, f. o. b. steamers Rio Janeiro. The high ore market continued to stimulate exportations of of the home makers and these furnaces competing among themselves cut to $155, delivered in November. Prices were steady around $165, delivered, at the year's close.

Average contract prices of ferro-manganese at eastern seaboard, based on actual sales for four years are:

	1916	1915	1914	1913
January	$110.00	$ 68.00	$ 36.00	$ 65.00
February	140.00	100.00	38.00	65.00
March	175.00	100.00	38.00	65.00
April	175.00	100.00	38.00	61.00
May	175.00	100.00	38.00	61.00
June	175.00	105.00	37.50	61.00
July	175.00	103.00	37.50	58.50
August	170.00	105.00	100.00	56.00
September	164.00	110.00	80.00	55.00
October	160.00	105.00	66.00	50.00
November	155.00	100.00	66.00	50.00
December	162.50	100.00	68.00	45.00

Average monthly prices for 20 per



CONTRACT PRICES FOR FERRO-MANGANESE, TIDEWATER, 1912-1916

gency gradually subsided until in July forward and spot prices coincided.

Foreign manganese ore was used almost exclusively by home makers of ferro-manganese and the tonnage imported was the largest of any year, approximating 550,000 to 600,000 tons. Brazil furnished the overwhelming bulk of the imports with about 500,000 tons. India contributed about 50,000 tons and Cuba about 20,000 tons. Japan shipped in several thousand tons and a moderate quantity was received from Panama. The prices for manganese ore were extraordinary and reflected the shortage of vessels and the phenomenal freight rates. In January, 1916, Brazilian ore was selling at 58 cents per unit, at Atlantic seaboard; Indian at 65 to 70 cents and Cuban at 50 cents. The market advanced. Brazilian ore was quoted at 63 cents in March and sold at 72 new and the opening of old domestic deposits, but the success of these was limited owing to the small tonnage. Virginia was the principal source of this activity and considerable new capital was invested there. In August, the Carnegie Steel Co. advanced its offers on domestic ore to 55 cents, delivered to the furnaces, for 49 per cent ore; 53 cents for 46 to 49; 50 cents for 43 to 46; 46 cents for 40 to 43. This, by far, was the highest prices it ever had paid.

Contract English ferro-manganese on Jan. 1, 1916, was at $110, seaboard. On Jan. 8, it advanced to $125; on Feb. 11 to $150, and on March 2 to $175. This last price prevailed to September when, under increasing competition from domestic makers, it was dropped to $164. During the last several months of the year, the market was completely in the hands

cent spiegeleisen for the past two years have been as follows:

	1916	1915
January	$ 32.50	$ 25.00
February	42.50	25.50
March	55.00	26.00
April	60.00	26.00
May	60.00	26.00
June	55.00	26.00
July	47.50	26.00
August	47.50	26.00
September	45.00	29.00
October	40.00	30.00
November	45.00	30.00
December	50.00	30.00

Manufacturers of bessemer ferro-silicon entered the year of 1917 with enough tonnage on their books to maintain present operations well into the second quarter of the year. Early in 1916, 10 per cent material sold at $28 per ton, at the furnace; sales at $42 per ton were made the early part of December. Fifty per cent ferro-silicon, demand for which was heavy, advanced from $83 to $100, Pittsburgh, per ton.

Prosperous Year in Coke Market

After Long Period of Depression Comes Heavy Demand and Largest Production on Record—Serious Trouble Owing to Shortage of Labor and Cars

BY S. G. BACKMAN

THE MARKET for Connellsville coke, after struggling through a period of depression that extended over several years, displayed remarkable recuperative ability in 1916. Blast furnace and cupola fuel for prompt and future shipment sold at the highest prices recorded in a decade or longer. Furthermore, the production of coke in the Connellsville regions in 1916 was greater than that of any similar period in the history of the beehive oven industry of western Pennsylvania.

Connellsville cokemakers prospered last year, notwithstanding the continued growth and development of the by-product coke oven industry. More than 1,000 retort ovens were put into operation in 1916 by owners of merchant and steelworks blast furnaces who had previously depended entirely or in part upon the Connellsville district for fuel. It is not suprising that demand for coke was heavier than in previous years, since blast furnaces broke all production records in the 12-month period just ended, making approximately 40,000,000 tons of iron. New retort oven capacity did not offset the increase in the consumption of blast furnace fuel.

The average monthly price of Connellsville furnace coke for prompt delivery was $2.34 in 1913; $1.75 in 1914; $1.78 in 1915, and $3.35 in the first 11 months of 1916. As high as $8.25 a ton was paid for spot 48-hour coke the latter part of the year just ended. Contract furnace coke, offered at $2.25 and $2.35 a ton the latter part of 1915, commanded $5 a ton the latter part of 1916. Connellsville foundry coke for spot shipment sold at an average monthly price of $3.06 in 1913; $2.29 in 1914; $2.24 in 1915, and $3.94 a ton in the first 11 months of 1916. Cupola coke sold at $10 a ton the latter part of December.

THE market for both furnace and foundry coke displayed its greatest strength in the first and fourth quarters of the year just ended; the market dragged somewhat from April 1 until Oct. 1. Spot furnace coke, which sold at an average price of $3.55 in March, was obtainable at as low as $2 a ton in May. The congested traffic situation, which cut off the shipment of coal to by-product plants in many instances, combined with a shortage of coke, so acute that several blast furnaces had to bank their fires, enabled Connellsville sellers to advance prices to "war-bride" levels in the fourth quarter of the year. The average price of spot furnace coke in November was $4.87 a ton. Foundry coke for immediate delivery sold at a range from $3 to $4 a ton in the first 10 months of 1916; in November and December, consumers paid as high as $10 a ton for cupola coke.

Blast furnace coke for future shipment sold at monthly average prices ranging from $2.38 to $2.98 in the first half, and from $2.40 to $5 a ton in the second half of the year. Contract foundry coke, the first six months, sold at $3 to $3.75 and at $3.15 and $7 the last six months of the year. Scarcely any coke was sold on sliding scale contracts in 1916.

Ovens in the Connellsville regions produced more than 22,000,000 tons of coke in 1916, compared with 20,097,901 tons in 1913, the previous banner year. Only eight times in the year of 1916 did weekly production fall below 400,000 tons. Figures compiled by *The Connellsville Courier* show that 5,606,120 tons were produced in the first quarter; 5,676,652 tons in the second; 5,630,321 in the third, and 4,162,823 tons in the first and second months of the fourth quarter of 1916. The *Courier's* figures show that production to Dec. 3 was 21,169,889 tons.

1916 Coke Prices

MONTHLY MINIMUM PRICES CONNELLSVILLE FURNACE AND FOUNDRY COKE PER TON AT THE OVENS IN 1916.

	Furnace.		Foundry.	
Months.	Prompt.	Contr.	Prompt.	Contr.
Jan.	$3.06	$2.38	$3.75	$3.00
Feb.	3.25	2.50	3.75	3.75
Mar.	3.55	3.80	3.60	3.90
Apr.	2.37	2.98	3.87	3.50
May	2.1875	2.60	3.125	3.50
June	2.44	2.63	3.00	3.50
July	2.64	2.42	3.00	3.15
Aug.	2.71	2.40	3.05	3.15
Sep.	2.875	2.4875	3.25	3.175
Oct.	4.875	3.375	4.375	4.875
Nov.	7.25	3.75	9.00	5.50
Dec.	7.50	3.72	9.25	6.00
Av. for yr.	4.25	2.94	4.42	3.91

Many New Ovens Built

Some of the most conspicuous buyers of Connellsville furnace coke withdrew from the market in 1916, having completed by-product coke plants. In the year, 204 retort ovens were completed by Corrigan, McKinney & Co., Cleveland; 204 by the Youngstown Sheet & Tube Co., Youngstown; 412 by the Bethlehem Steel Co., South Bethlehem, Pa.; 94 by the Toledo Furnace Co., Toledo, O.; 47 by the United Furnace Co., Canton, O.; 94 by the La Belle Iron Works, Steubenville, O.

There were no especially important or interesting aspects of eastern coke conditions during 1916. Prices paid for eastern furnace and foundry buyers for spot fuel during periods of freight embargoes, car shortages, etc., were extraordinarily high. During the general tie-up in the east in March, local by-product foundry coke for spot shipment brought from $14 to $16 at the ovens, in New England. Similar prices were paid in that district, when the New Haven railroad embargoed coke shipments in November for a few weeks. When the general coke shortage developed in October, a number of the eastern furnaces were obliged to bank from time to time because of insufficient fuel. In one instance, one company bought spot coke at a high price in order to get sufficient fuel with which to bank its furnace. Numerous inquiries for coke for export appeared from time to time during the year and considerable business in foundry and smelter fuel principally with South America was done. There were some inquiries also for European shipment.

In the southern coke market during 1916, inquiry, taken as a whole throughout the year, was as good as has ever been experienced in the history of the market. This, however, was counterbalanced by the fact that production was greatly handicapped through an acute shortage of labor at times when it was most needed at

the ovens, and by an ever increasing scarcity of equipment in which to ship on contracts. During the last quarter of the year, production was reduced still further when operators began selling coal direct rather than turn it into coke. The price of the raw material rose to such an abnormal figure that much more profit could be derived by selling it direct. Also, the trouble of turning it into coke, made more objectionable by the above mentioned shortage of labor and equipment, was not encountered. Shipments on contracts were heavy throughout the entire year, and during almost all of the last half, specifications were in excess of production. This caused spot coke to be placed at a premium, as a large number of melters could not get as much as desired on their contracts, with the result that they were forced to make spot purchases from time to time to fill in between shipments. Towards the last of the year, some spot foundry coke sold as high as $8 and $10 a ton, ovens. These fancy prices were readily paid by many users who, unable to receive satisfactory shipments on contracts, faced the proposition of closing their plants or paying the price asked for spot shipment fuel.

The situation in regard to spot coke during the beginning of 1916 was the direct reverse of that during the last half. The year opened with spot fuel weak, because several furnaces, which were expected to blow in, and for which coke had been purchased, remained idle, with the result that operators found themselves with all of this coke upon their hands. Low prices were made to sell it and it was quickly disposed of before the end of January. Shipments on contracts in January were good on both furnace and foundry grades, and late that month and early in February, melters began to complain of being unable to secure the tonnages specified in their contracts. During the latter part of February, the heaviest buying movement of foundry coke ever experienced in the southern market began when foundries came out for yearly requirements beginning July 1 and extending until July 1, 1917. Spot coke also became scarce, and consumption was soon in excess of production. Buying by foundries continued brisk throughout March with the result that prices advanced. Early in May, after the majority of foundries had covered for yearly requirements, the situation began to slow up. The market was quiet during the last three weeks of May, and continued the same through June, with the result that prices weakened, and were reduced to the same basis that prevailed at the beginning of the year. Continued lack of demand through July and August caused prices to remain unchanged, but as shipments on contracts on both furnace and foundry grades were exceptionally heavy, production, which was handicapped because of shortage of labor, became less than consumption. This strengthened conditions slightly, but not enough to bring about an advance in prices. Early in September, southern and southern Ohio furnaces began to come into the market, and during that month practically all stacks in those districts purchased for the last quarter of 1916 and the first half of 1917. Shipments of foundry coke continued heavy, and in a number of cases, tonnages in excess of contracts were asked. The result was that prices were advanced to the level they held in March.

In October, production, which was already handicapped by shortage of labor, and equipment in which to

Record of Alabama Coke Industry

Bee Hive	9,124
By Product	750
	9,874

NUMBER OF OVENS IN AND OUT OF COMMISSION ON DEC. 1, 1916

Name of operator.	Kind.	Total.	In.	Out.
Republic Iron & Steel Co., Birmingham	Bee Hive	1,010	910	100
The Alabama Co., Birmingham	Bee Hive	915	750	165
Tennessee Company, Birmingham	Bee Hive	3,104	2,000	1,104
Tennessee Company, Birmingham	By Product	280	280	0
Sloss-Sheffield Steel & Iron Co., Birmingham	Bee Hive	1,373	1,173	200
Woodward Iron Co., Birmingham	Bee Hive	794	594	200
Woodward Iron Co., Birmingham	By Product	170	170	0
Semet-Solvay Co., Birmingham	By Product	300	300	0
Central Iron & Coal Co., Holt, Ala	Bee Hive	160	0	160
Yolande Coal & Coke Co., Birmingham	Bee Hive	150	150	0
Sayre Mng. & Mfg. Co. (opr. by Sloss)	Bee Hive	150	150	0
Gulf States Steel Co., Birmingham	Bee Hive	301	301	0
U. S. Cast I. P. & Fdy. Co., Bessemer	Bee Hive	100	100	0
Empire Coal Co., Birmingham	Bee Hive	100	50	50
Pratt Consol. Coal Co., Birmingham	Bee Hive	60	0	60
Imperial Coal & Coke Co., Birmingham	Bee Hive	103	0	103
McCormack & Ramsey (Newcastle) B'ham	Bee Hive	374	374	0
Lookout Mtn. Iron Co., Battelle	Bee Hive	150	0	150
Jenifer Furnace Co., B'ham	Bee Hive	100	0	100
Seaboard Coal & Coke Co., Talladega	Bee Hive	180	0	180
		9,874	7,302	2,572

NOTE:

Gulf States Steel Co. erecting	37 by product ovens
Woodward Iron Co. erecting	60 by product ovens
	97

. These ovens will be ready for operating in 1917.

	Bee Hive.	By Product.	Total.
Ovens in commission Jan. 1, 1916	2,780	400	3,180
Ovens in commission July 1, 1916	4,505	750	5,255
Ovens in commission Dec. 1, 1916	6,552	750	7,302

Coke Production in Wise County and New River Fields in 1916

Wise County District. Name of operator—Location.	No. ovens controled.	Percentage operating a year ago.	Percentage operating today.
Stonecga Coke & Coal Co., Big Stone Gap, Va	1,900	100	70
Virginia Iron, Coal & Coke Co., Roanoke, Va	1,400	100	90
Stone Gap Colliery Co., Glamorgan, Va	350	45	65
Colonial Coal & Coke Co., Dorchester, Va Wise Coal & Coke Co., Dorchester, Va Sutherland Coal & Coke Co., Dorchester, Va	750	70	70
Intermont Coal & Coke Co., Big Stone Gap, Va	80	100	100
Blackwood Coal & Coke Co., Blackwood, Va	282	40	65
Norton Coal Co., Norton, Va	150	50	60
Esser Coal & Coke Co., Esserville, Va	80	100	100
Empire Coal Land Corporation, Alfredton, Va	100	50	50
	*5,092	‡72.8	‡74.4
New River District.			
Turkey Knob Coal & Coke Co., Turkey Knob, W. Va	100	100	100
Branch Coal & Coke Co., Elverton, W. Va	60	...	80
Babcock Coal & Coke Co., Sewell, W. Va	193	80	100
Lowmoor Iron Co., Lowmoor, W. Va	140	100	100
Fire Creek Coal & Coke Co., Fire Creek, W. Va	96	100	100
Nuttallsburg Smokeless Fuel Co., Nuttallsburg, W. Va	60	100	100
Kaymoor (own'd by Lowmoor Iron Co.), Kaymoor, W. Va.	200	100	100
Gauley Mountain Coal Co., Austed, W. Va	150	100	100
Mt. Carbon Co., Powellton, W. Va	202	100	60
Brooklyn (own'd by New Riv. Coal Co.), Brooklyn, W. Va.	66	...	100
	*1,267	‡65	‡94

‡Average.
*Total ovens controled.

ship coke, was lessened still further when operators began selling coal direct rather than to turn it into coke. As already stated, the price of coal had gradually risen to such height that much more profit could be derived from selling it direct. During this month a good demand for both furnace and foundry coke for spot delivery developed, as melters were unable to secure sufficient quantities on contracts, and needed fuel to fill in between shipments. Prices began a gradual advance.

In November the market became wild and uncertain. Dealers had no coke to sell and melters were scrambling for any lots they could secure. Shipments on contracts were far below specifications, as neither fuel nor equipment could be had. Spot coke demanded a premium, depending upon conditions surrounding each sale. Prices gradually advanced for contract delivery, although definite quotations could never be given. The same condition continued through December. Towards the last of that month, ovens offered contracts for 1917 shipment on furnace coke, and on limited tonnages of foundry coke. A premium was also asked, ranging from $1 to $3 a ton, for first half delivery. Spot coke at the end of the year was selling from $6 to $10 per ton, ovens, depending upon conditions surrounding each sale.

Coke production in the Wise county district for the year 1916 was 74.4 per cent of capacity of the ovens, in comparison with 72.8 per cent for the year 1915. In the New River district production for 1916 was 94 per cent in comparison with 65 per cent in 1915, as shown in the accompanying table. Pocahontas operators produced about 75 per cent of capacities in 1916 as compared with 50 per cent in 1915.

Alabama's Great Record

The coke market of Alabama and the Birmingham district has eclipsed all previous records as to demand and prices obtained. Production of coke in Alabama has far exceeded all previous records. The banner production year was 1913, showing a production of 3,531,505 tons. The present rate of production is on the basis of 5,000,000 tons per annum.

Operators were handicapped continually by shortage of labor, which caused production to fall below consumption during the last half. Only occasionally were operating companies able to run at full capacities. Not only was labor scarce at all times, but railroad equipment could not be secured in sufficient quantities to handle shipments. Frequently production was curtailed because no cars were to be had to load. Coal mining companies towards the end of the year sold coal direct rather than turn it into coke because a better profit could be derived from the sale of the raw fuel, which rose to abnormal prices during the last quarter of the year.

Prices on Alabama coke were strong at all times. Shipments on old contracts were always heavy, and users usually showed a willingness to pay fancy prices for certain tonnages to fill in between lots specified in contracts. Shortage of coke in other fields left Alabama producers without competition, with the result that no trouble was experienced in maintaining a high level of quotations throughout the year. Alabama furnace coke at the beginning of 1916 was quoted from $2.75 to $3, ovens, and foundry coke from $3.75 to $4, ovens. In February, the price of furnace grades was advanced 10 cents a ton. Another slight advance took place on both grades in March, the average for furnace coke being from $3 to $3.25, and for furnace coke, $4, ovens. Slight advances of from 10 to 25 cents a ton each month, as shown in the accompanying table, continued until late in October, when the market suddenly became active and quotations were bettered in a rapid and sensational manner, due to causes stated above. Today prices are as follows, ovens: Furnace coke, $4 to $4.25, and foundry coke, $5.50 to $7.50.

Virginia, West Virginia and Alabama Coke Prices

MONTHLY CONTRACT PRICES FOR THE YEAR 1916.

—New River—		—Alabama—		Date.	—Wise County—		—Pocahontas—	
Furnace.	Foundry.	Furnace.	Foundry.	1916.	Furnace.	Foundry.	Furnace.	Foundry.
$3.00-3.25	$3.25-3.75	$2.75-3.00	$3.75-4.00	January	$2.85-3.10	$3.25-3.50	$2.75-3.00	$3.00-3.25
3.00-3.25	3.38-3.88	2.85-3.00	3.75-4.00	February	2.85-3.18	3.25-3.68	2.80-3.13	3.08-3.38
3.25-3.50	3.75-4.25	3.00-3.25	4.00	March	2.93-3.25	3.50-3.75	2.93-3.25	3.25-3.75
3.25-3.50	3.75-4.25	3.15-3.50	4.25	April	3.00-3.25	3.50-3.75	3.00-3.25	3.25-3.75
3.25-3.50	3.75-4.25	3.20-3.50	4.50	May	3.00-3.25	3.50-3.75	3.00-3.25	3.25-3.75
3.25-3.50	3.75-4.25	3.20-3.50	4.20-4.50	June	2.93-3.25	3.50-3.75	2.93-3.25	3.25-3.75
3.25-3.50	3.75-4.25	3.15-3.35	4.25-4.50	July	2.85-3.25	3.50-3.75	2.85-3.25	3.25-3.75
3.25-3.50	3.75-4.25	3.00-3.25	4.25-4.50	August	2.85-3.25	3.50-3.75	2.85-3.25	3.25-3.75
3.25-3.50	3.75-4.25	3.00-3.35	4.35-4.75	September	2.93-3.25	3.50-3.75	2.93-3.25	3.25-3.75
3.58-4.00	4.17-4.67	3.00-3.50	4.50-5.00	October	3.33-3.75	3.83-4.25	3.33-3.75	3.75-4.25
4.25-5.50	5.25-5.75	3.50-3.75	4.85-5.35	November	4.25-5.00	5.00-6.00	4.25-5.00	5.00-6.00
5.00-5.50	5.25-5.75	4.00-4.25	5.50-7.50	December	4.50-5.00	5.00-7.00	4.50-5.00	5.00-7.00

Warehouse Orders

Limited by Ability to Replenish Stocks —Peculiar Situation

Steel warehouses during 1916 faced a situation which tested to the utmost their ability to serve patrons. The volume of business was limited only by the tonnage they could obtain from mills, as demand was much larger than they could serve. The problem then was to distribute their steel in a way to do the best justice to the situation.

With mill deliveries deferred many months, efforts were made by consumers to buy in large tonnages from store. Of course, it was impossible to fill this demand, but unusually large sales were made in cases where there was a pressing necessity that could not await slower deliveries from mills. Smaller fabricating shops have obtained a large portion of their material from store for several months in some localities.

Under the circumstances, assortments have been depleted much of the time and shipments in many cases have not been with the usual promptness that has marked warehouse business in the past. Sizes most in demand have been practically out of stock in many stores most of the year, as delayed orders would absorb any supply received from mills. Plates seemed to be under the greatest pressure in all markets, warehouses naturally being looked to for relief from scarcity of supply.

Prices on steel from store advanced through the year at about the same rate as mill material. The range of increase is from $25 to $50 per ton, the great spread resulting from the heavier advance in plates. At New York, the increase was most marked. In that market, bars and shapes rose from 2.40c at the beginning of the year to 3.75c at the end, an increase of $27. Plates were quoted at 2.50c at the opening of 1916 and at the close wide plates are 5c and narrow sizes are 4.75c. This is an increase of $50 per ton on the former and $45 per ton on the latter.

In the Chicago market, bars rose $24 from 2.40c to 3.60c. Shapes increased the same amount, from 2.50c to 3.70c and plates were raised $37 from 2.50c

to 4.35c. Other centers made gains at about the same rate and the experience of all ran parallel as to demand and difficulty in keeping up assortments.

A peculiar situation developed in the west about the middle of the year when the price of structurals had carried the quotation on fabricated material so far above previous experience that a lull came in buying and it seemed that prices had passed the ability of consumers to pay. A number of small fabricators believed their highway bridge business had been killed by prices and issued stock lists of their material on hand, preferring to take the handsome profit from advanced prices rather than hold the material. Some tonnages were taken in this way which otherwise would have gone to warehouses. When matters adjusted themselves later, the same fabricators paid higher prices for material from store.

A novel slag pocket for an open-hearth furnace has been invented by E. H. Holzworth, Lowellville, O. The invention consists essentially of numerous sub-pockets arranged end to end on fixed side walls. Chain links, arranged in these pockets so as to be enclosed in the slag, readily engage a crane hook when it is desired to remove the slag.

Rail Sales Break Record

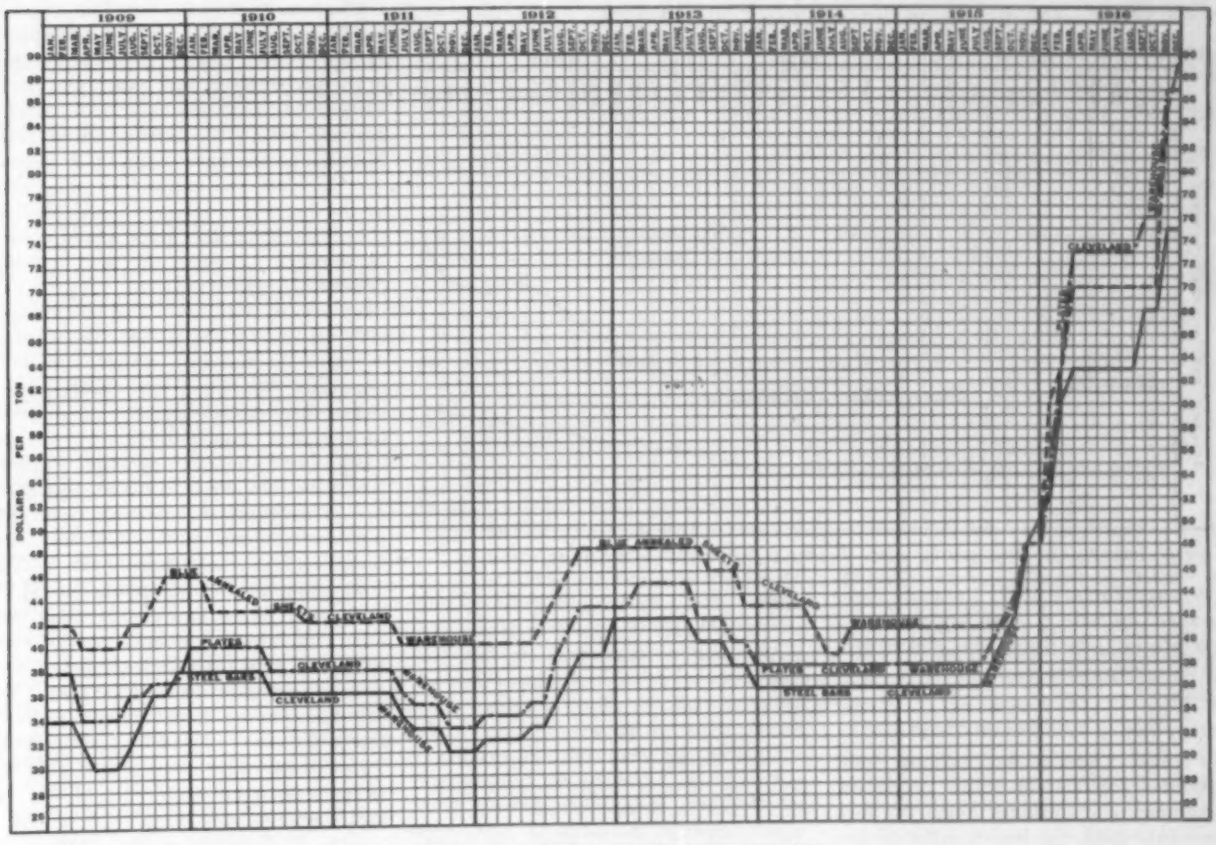
MORE rails were bought in the United States during 1916 than in any other single year. This was due to the fact that the deliveries arranged for by domestic roads covered a wider range than ever before. Instead of the time-honored covering of requirements for the current year, the railroads were forced by the extraordinary general pressure for steel upon the mills to do their buying for two and in some cases for three years as a matter of protection to themselves. Furthermore, they did this buying at the highest prices for steel rails since the time the latter became a large tonnage product of the mills. Foreign buying of rails, which by a wide margin was the largest in history, also made a notable contribution to the year's sales tonnage.

Tremendous Orders Booked

It is estimated that total rail orders closed with the mills during the past year call for not less than 4,500,000 to 5,000,000 tons. This total represented the piecing-out of 1916 requirements, the placing of 1917 needs complete, the covering of a considerable portion of the 1918 budget and the large foreign tonnage. It was an unusual thing to see leading railroad systems duplicate their annual orders a few months apart. Thus, the Pennsylvania placed two lots of 205,000 tons each, and the New York Central lines two of 150,000 to 175,000 tons each for the years 1917 and 1918, respectively.

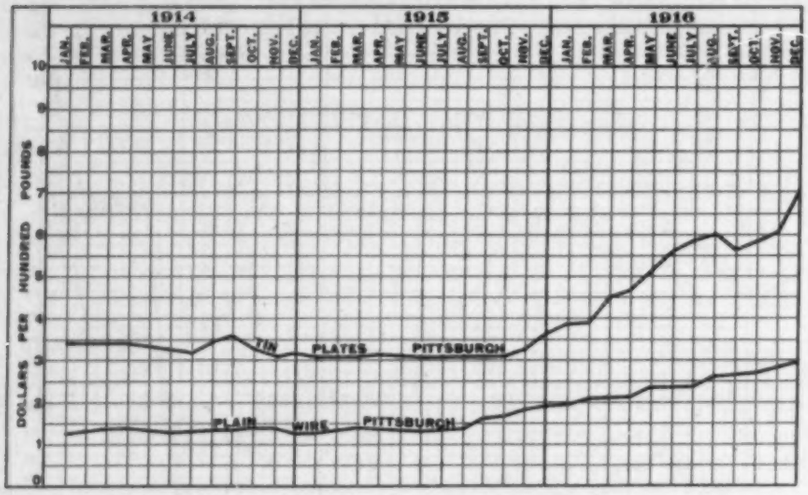
Nothing has been more expressive of the remarkable character of the year in the steel market than the course of rail prices in 1916. For the first time in 15 years, or since about the time of the formation of the Steel Corporation in 1901, the unbroken line of $28 and $30 rail prices succumbed to the forces of raw steel supply and demand.

Early in April the mills were filling up so rapidly in miscellaneous products against their 1917 output that the railroads began to show anxiety in their rail positions for that year, notwithstanding the fact that some of them, at that time, had not yet completed their 1916 purchases. The customary rail prices then had fallen far



WAREHOUSE PRICES, CLEVELAND, 1909-1916

out of line with those ruling on other rolled products, some of them of a less highly finished character than rails. Furthermore, manufacturing costs were rising steadily. March showed the placing of heavy orders of not less than 800,000 tons. This led to the announcement by Chairman Gary, of the Steel Corporation, April 4, that after May 1 the mills would accept no more rails for delivery after May 1, 1917, at the old prices. On April 13, an advance of $5 a ton to $35, mill, for open hearth, and to $33, mill, for bessemer, finally was fixed upon by the makers. The railroads showed no hesitancy in buying as the advance was in all respects a very conservative one and a heavy contracting movement quickly followed. April was a month of heavy bookings, which totaled 800,000 tons or more. But the climax of the greatest export buying of steel rails ever known was reached in July, when the Russian government railways distributed the largest single rail order ever closed in this country. This order called for between 425,000 and 450,000 tons of 67½-pound rails and accessories and was distributed among the Steel Corporation, Cambria, Bethlehem and Lackawanna Steel companies. The price was from $51 to $52, alongside New York, or from $49 to $50 at the mill. French railways also were large buyers during the year and placed several hundred thousand tons. Italy was an important buyer. Canadian roads also placed sizeable tonnages on this side owing to the filled-up condition of the home mills on war business. On all this export business higher than domestic prices were obtained. Some smaller sales were made as high as $50 to $55, mill.


1914
1915
1916
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
DOLLARS PER HUNDRED POUNDS
0 1 2 3 4 5 6 7 8 9 10
TIN PLATES PITTSBURGH
PLAIN WIRE PITTSBURGH

PRICES OF TIN PLATE AND PLAIN WIRE, PITTSBURGH, 1914-1916

The remaining 1917 tonnage was cleaned up with a rush and within a few weeks. By June, the entire estimated requirements were on mill books.

Buying for Distant Future

Full-tide buying of various steel products for distant-future deliveries, continued and business began to flow over into 1918. A few months of this and interest appeared among different domestic systems in rails for shipment after Jan. 1, 1918. The mills at first declined to consider these rail orders 16 to 18 months ahead. The roads pressed their inquiries and finally, on Nov. 15, the rail books for 1918 were opened at a second advance of $5 a ton, which placed open hearth at $40, and bessemer at $38, mill. In the closing months of the year this contracting for 1918 was well under way and it was estimated that fully 1,000,000 had been booked, leaving only a moderate proportion of requirements still to be covered by the railroads.

Although a large part of this foreign tonnage yet is to be delivered, notably that to Russia, where the shipment is to be by July, 1917, the exports of the year reflected the heavy sales abroad. For the 10 months ended October, they were 444,202 tons, which clearly indicated a new high record and an increase over the former banner year of 1912 with 460,533 tons.

Railroad spikes failed to develop the strength reflected by other finished lines in 1916. During the latter part of the year, they were sold far out of line with the prevailing price of steel bars. They sold at a range from 2.10c to 2.50c, mill, or Pittsburgh, in the first quarter and at 2.65c in the second, third and greater part of the fourth quarters. Early in December, manufacturers put up prices to 3.40c, declaring that they would not operate spike machines unless able to obtain remunerative prices for their product.

Definitely reported, rail orders by months for recent years, as compiled by *The Iron Trade Review*, are as follows:

	1916.	1915.	1914.
Jan.	200,000	200,000	175,000
Feb.	140,000	150,000	215,000
Mar.	800,000	160,000	60,000
Apr.	800,000	65,000	60,000
May	75,000	140,000	110,000
June	125,000	225,000	215,000
July	500,000	240,000	130,000
Aug.	100,000	145,000	70,000
Sep.	50,000	325,000	40.000
Oct.	325,000	590,000	30,000
Nov.	500,000	150,000	115,000
Dec.	500,000*	200,000	30,000
	4,115,000	2,590,000	1,250,000

*Estimated.

Tin Plate

Prices Rise to High Point as Production Greatly Increases

The wave of prosperity that started to sweep over the tin plate industry of the United States in 1915, became more pronounced last year, and indications are that its crest will not be reached before the latter part of 1917. Manufacturers have sold their output for the first six months of this year at the highest prices ever recorded in the history of tin plate manufacture in America. Despite the fact that the producing capacity of the country has been almost trebled in the last decade, tin and terne plate makers are unable to meet the demand, which is becoming more diversified each year.

The market for shipment of tin plate in the first half of 1917 was opened early last October by the Phillips Sheet & Tin Plate Co., at $6, base, for 14 x 20 prime bessemer coke, 100 pounds f. o. b. mill. On Oct. 13, however, the American Sheet & Tin Plate Co. opened its books at $5.75, base, and those figures represent the prices at which the bulk of the tonnage was sold for distribution the first and second quarters of this year. No tonnage was sold last year for delivery after June 30, 1917; in previous years, consumers had been able to cover estimated requirements for an entire season.

The $5.75 price is the highest at which any season ever opened in the history of American tin plate manufacture; the nearest approach to it was the price of $4.65, named on Aug. 6, 1899. When the American company formally announced its price last October, sheet bars were selling at a range from $45 to $50, mill, and pig tin was listed at 42 cents a pound. In 1915, the market was opened on Nov. 11, at $3.60, base. On that date, sheet bars were quoted at $27.50 and pig tin at 38½ cents a pound. The price named for shipment the first half of this year is $2.15 a box above that announced at the opening of the 1916

season. Before the close of last year, scattering lots of tin plate were sold at as high as $7, base.

Demand was augmented considerably by the placing of contracts for shipment abroad. Great Britain, it will be recalled, prohibited the export of tin plate, which compelled foreign consumers to turn to this country for relief. In the first nine months, 179,126 tons of tin plate were exported by American manufacturers; the bulk of this tonnage was consigned to Canadian interests.

Further provision for increasing the capacity of tin plate mills was made in 1916. The American Sheet & Tin Plate Co. will have its 24 mills at Gary, Ind., in operation at an early date, and is rushing work on the installation of 10 additional mills at Farrell and a similar number at New Castle, Pa. The Standard Tin Plate Co. completed 10 mills; the McKeesport Tin Plate Co., 20 mills; the Phillips Sheet & Tin Plate Co., four mills, and the Wheeling Steel & Iron Co., six mills during the year just ended.

Wire Products

In Great Demand From Belligerent Nations—Prices Advance

Although the steel market in general has felt the effect of export demand keenly and has responded to its stimulus in every department, wire has been affected rather more sharply than many other products. This demand was principally for barbed wire, for use in military entanglements. In the first 11 months of the year, 765,897,525 pounds of barbed wire, valued at $24,971,749 were shipped to foreign countries. General wire products in addition, totaling 473,907,476 pounds, valued at $15,982,073, were exported by American manufacturers.

Prices advanced rapidly through the year and higher levels are forecast for the present year, the situation as to supply and demand indicating the probability of both wire products and nails attaining record levels. During the first 11 months of 1916, wire products were advanced from $2.10 to $3 a keg for nails and from $1.95 to $2.95 per 100 pounds for plain wire. General advances of $2 per ton net were made Jan. 24, Feb. 12, March 1, May 1, Aug. 7 and Oct 18. Advances of $3 per ton were made Nov. 4 and Nov. 24. The differential for wire for the manufacturing trade was increased to 10 cents per 100 pounds.

Only once since 1898 have wire products been quoted above $3 a keg as the base price for nails. John W. Gates, then a prominent factor in the wire market, advanced wire products $5 per ton, from $2.95 to $3.20 base for nails, Dec. 30, 1899. A short time later, nails dropped to $2.20 per keg, a loss of $1. Since then, the market never has even approached $3 until this year.

Observers who keep in close touch with the market believe that the first quarter of 1917 will find wire products selling on a basis of $3.25 a keg for nails. That will be a record price for this product and will overtop all previous prices, should it be attained.

The situation has been tightening for some time and for several months past manufacturers whose custom has been to sell for delivery in 60 days have been willing to sell for no longer delivery than 30 days.

A peculiar condition existed through part of the year, the relation between wire and fencing being such that manufacturers having a supply of the former found it more profitable to sell it than to fabricate it into fencing. Considerable trading of this kind was done before the market righted itself and restored relations to a basis more nearly normal.

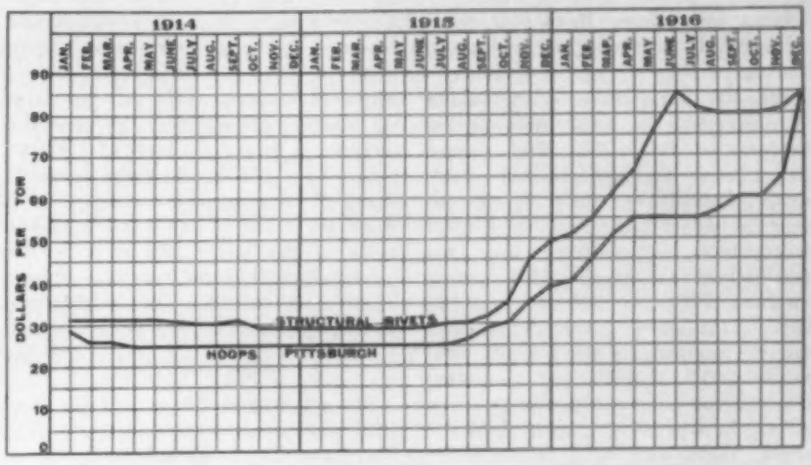
The present price of wire products is double that prevailing two years ago, nails being quoted at $1.50, Jan. 1, 1915, and at $3 the close of 1916. The advance in 1915 was $12 per ton and in 1916 it was $18 per ton. This increase is less than that registered by most other steel products and wiremakers claim their prices are far below the usual relation which had previously existed between steel bars and wire products.

Examination of the usual spread indicates the truth of the claim and this is one of the strong factors indicating a further rise in wire products regardless of the course of other steel lines.

Bolts and Nuts

Enjoy Extremely Active Demand—Rivets Also Sell Freely

Manufacturers of bolts, nuts and rivets have enjoyed an almost unprecedented demand for their product in the past year. Before 1916 was well advanced, general business had taken so great a forward impetus that manufacturers saw a tremendous demand for their varied lines of output and began to contract for their requirements in raw material and parts. Ship builders sought to buy rivets by millions and car builders bought in immense volumes as well. Every line using bolts—stovemakers, agricultural implement and vehicle builders and a host of others—began to place orders and in a short time mills found themselves booked well into the future.



PRICES OF STRUCTURAL RIVETS AND HOOPS, PITTSBURGH, 1914-1916

Prices naturally advanced on this strong demand, particularly as raw materials and labor were going higher steadily. Some users of bolts believed prices were advanced too rapidly and having a fair supply on hand waited to buy when the decline should come. This failed to materialize and they bought at much higher levels, if they were able to place contracts at all.

During much of the latter part of the year, most bolt and rivetmakers were booked far ahead and many would not take on further business. At the beginning of 1917, most mills have orders sufficient to give operation at maximum rate for three to six months. At the same time, there is strong demand from consumers which cannot be filled for months.

During the first 11 months of 1916, structural rivets advanced from 2.50c to 4.25c, or $35 per ton. Other rivets advanced in like degree and changes in the price of bolts and nuts were equally marked.

Tremendous Buying of Shell Steel

Is Leading Feature of Semi-Finished Material Market and Causes Shortage in this Country—Many Makers of Finished Products Are Embarrassed—Prices Advance to High Levels

THE market for semi-finished steel products in 1916, as was the case in the previous year, continued to offer some extraordinary features of unusual interest. Domestic activity was augmented greatly by the demand for steel for the manufacture of munitions in this country and abroad. This demand ranged from 3¼-inch rounds for the manufacture of shrapnel to 6, 7, 8 and 9-inch blooms for high explosive shells. All of the entente nations were conspicuous buyers of munitions and semi-finished material.

Buying of shell steel from steelmakers in the United States during 1916 reached superlative proportions, and there is good ground for the statement that the aggregate of the orders closed during the past 12 months was from 4,000,000 to 5,000,000 tons. A considerable part of this tremendous tonnage covered the requirements of the domestic industrial companies which have been manufacturing finished shells for the foreign belligerents, but the overwhelming bulk of it was purchased for export in bloom and billet form by the warring governments, particularly France and England. At the beginning of 1917, it was estimated that the steelmakers had on their books orders for at least 3,000,000 tons of shell steel for delivery abroad during the next 12 months. The United States Steel Corporation was credited with about half of this tonnage in these estimates; one large eastern producer with about 500,000 tons; two other independent companies with 300,000 tons each, and several others with from 100,000 to 200,000 tons each. This 3,000,000-ton estimate did not include a heavy quantity of steel still to be shipped to domestic munition manufacturers.

THERE were three heavy buying movements of shell steel during the year of 1916. The first, during May, covered the requirements of domestic shellmakers, and a heavy tonnage for direct export to the foreign governments for delivery over the last half of the year. This buying ran from 500,000 to 1,000,000 tons. In August, the allied governments came into the market for their needs over the first half of 1917, and a number of additional contracts for large shells having been renewed with domestic works, there also was an extensive contracting for new requirements from that direction. The number of new finished shell contracts placed at this time with American companies, however, was more limited and these renewals were confined to those companies which had demonstrated their ability to make an acceptable product and to meet delivery specifications. This restricted contracting for finished shells reflected the fact that the preparations of the foreign governments to produce the major portion of their own munition necessities had reached an advanced point.

The crude steel orders placed by the foreign governments in August, however, were very heavy and totaled perhaps 1,000,000 to 1,500,000 tons. Three months later, the allied governments, becoming impressed with the rapid manner in which the American steel mills were selling their output for the year 1917, again entered the market and made their third large purchase of shell steel for delivery during the last half of 1917. Some of this steel, it is understood, will be delivered in 1918. This was the largest buying movement of the year and is believed to have exceeded 1,500,000 tons. Very few orders from domestic munition makers were included. Toward the close of the year, however, some of the latter still were in the market for uncovered portions of their needs, one of them for 50,000 tons, and another for 125,000 tons.

Advance in Prices

The prices paid during 1916 for shell steel were on an ascending scale. The May movement was around 3c to 3.25c, mill, net; that in August from 3.25c to 3.50c, mill, net; and that in November from 4c to 4.25c, mill, net. The prices quoted for export were on an f. o. b. mill basis, with the freight to tidewater prepaid. The significance of this was that the obligation of delivery was completed by the mill when the steel was placed on board the cars. The large foreign orders for shell steel were placed mainly by J. P. Morgan & Co. and by the French commission. There also was buying by other accredited representatives of foreign governments at New York. Among the domestic companies which bought large blocks of munition steel were the American Locomotive Co., the American Steel Foundries Co., the Pressed Steel Car Co, the Hydraulic Pressed Steel Co., E. W. Bliss & Co., the Baldwin Locomotive Works, the New York Air Brake Co., the Forged Steel Wheel Co., the American Car & Foundry Co., the American Can Co. and others.

Manufacturers of semi-finished steel products, including billets, sheet bars and wire rods were called upon by domestic manufacturers for tremendous tonnages of material in 1916. Makers entered the year with enough actual tonnage on their books to enable them to operate at maximum capacity through the first half. Mills in western Pennsylvania, eastern and northern Ohio enjoyed the highest prices in the history of the trade, surpassing records established in 1899, when billets sold at as high as $40, Pittsburgh.

Semi-finished steel products almost doubled in price during the year just ended. In the central west, billets were offered at $33 a ton and sheet bars at $34 a ton early last January; at the close of the year, both products were selling at $60 a ton and above. Rerolling billets in eastern Pennsylvania advanced in the year from $38 to $60, mill, and forging billets from $50 to $55 to $75 and $80. Moderate strength was displayed by the market in the central west during March and April, fairly heavy tonnages being sold at $45 a ton in the early part of the second quarter of the year. A slight recession in prices featured the market in May and June; both billets and sheet bars were obtained at $40 a ton in the early summer. The $45 price was re-established in August, however, and that figure easily was maintained in September and October. The mid-year decline in prices did not affect manufacturers to any appreciable extent, since most of them had sold their entire output on long-term contracts. In November, billets and sheet bars sold at $50 to $55 a ton

and in December some tonnage was sold at $60, mill.

Heavy Specifications

Specifications for sheet bars from manufacturers of sheets and tin plates were exceedingly heavy during the entire year. Many makers of finished commodities were handicapped considerably on account of the shortage of steel and deferred shipments. During the third and fourth quarters of the season, a number of sheet and tin plate makers were forced to close down finishing departments, on account of the shortage of raw material. It was almost impossible to buy semi-finished products for prompt shipment. The Carnegie Steel Co., the Jones & Laughlin Steel Co., the Youngstown Sheet & Tube Co. and the Republic Iron & Steel Co. did not figure in the market for spot delivery at any time during the year. In some instances, makers of sheet bars bought steel in the open market to fill orders for their finished steel commodities.

Consumers who covered requirements on long-term contracts did not pay anything like prevailing prices for nearby shipment at any time during the year. Manufacturers of sheets and tin plate were able to cover first and second quarter needs at considerably less than $35, mill; some tonnage, it is believed, was obtained in the first quarter at less than $30, mill. Sheet bars sold at from about $36 to $42, mill, for delivery in the third quarter of 1916 and as high as $45 was paid for tonnage for fourth quarter shipment. Some consumers, however, have covered requirements for the first three months of 1917 at less than $50, mill. Manufacturers of billets and sheet bars refused to protect their trade for more than six months, when books were opened for 1917 delivery. In previous years some of the larger users of billets and sheet bars were able to cover their requirements through an entire year.

The market in the year saw heavy offerings of shell steel crops and discards by the mills in all sections of the country. This material brought a variety of prices, ranging from $22.50 to $45, mill, in the east. In the central west, as high as $55 a ton was paid for discarded stock the latter part of the year. The offering of this class of high carbon steel materially assisted a great many consumers, whose operations otherwise would have suffered from the growing stringency in semi-finished products.

Wire Rods in Demand

Demand for wire rods was extraordinarily heavy during the entire year. Some manufacturers sold tremendous tonnages for shipment abroad and buying for domestic consumption was on a much broader scale than ever before. At the opening of 1916, wire rods sold at about $40 a ton; in April and May, they commanded as high as $55 a ton and $60 was paid for material before the opening of the second half of the year. In July, however, some tonnage was sold at $55, although sales at that figure were comparatively light. In November, the price was re-established at $60 and mills in a position to meet specifications for delivery experienced no difficulty in obtaining $65 and $70 a ton the latter part of 1916.

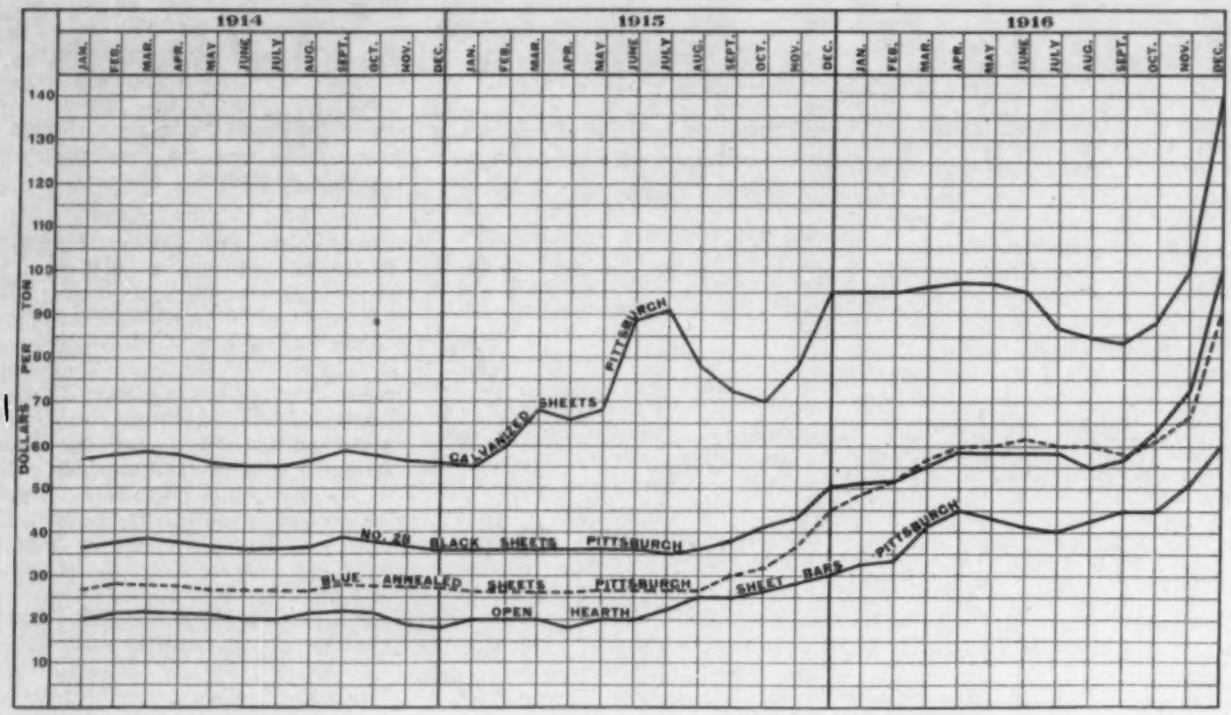
Sheetmakers Face New Year Confidently

MANUFACTURERS of steel sheets enter the new year under conditions which differ radically from those which were faced at the beginning of 1916. Now they find sheet prices practically on a parity with those for other lines of finished steel; order books filled for weeks ahead, in fact, future bookings are limited only by the manufacturers' own unwillingness to accept more business; and a hale and robust revival of domestic demand. Twelve months ago, sheet prices were low compared with most other finished steel products, and were saved from being still lower by the high cost of raw materials and not by any widespread buying movement; order books were lopsided, filled for weeks ahead on some grades and open for the same period on others; domestic demand was nearly non-existent for certain grades and insistent for others. The sheet manufacturers, after a period of good profits following immediately after the opening of the war, and a succeeding interval of small profit, have again begun to share in the steel industry's prosperity. The problem of securing raw materials, both at fair prices and in sufficient tonnage, has become much more complicated and is growing more difficult of solution.

THE failure of the sheet market to share consistently in the general prosperity of the steel business originated from the fact that sheets were one of the few commodities which were not in immediate and eager demand from the nations at war. While bars, plates, semi-finished steel and other steel commodities began their long upward climb following the appearance of huge buying orders from abroad, sheets fell behind because of the absence of this demand. At the same time, prices rose slowly but surely, in sympathy not with a domestic buying movement, but owing to the inexorable pressure of higher costs for raw materials. Sheet manufacturers were forced to raise prices at the same time that they were seeking orders, and it was only natural that buyers were slow in placing business.

The spotted character of the demand also made for instability in the general sheet market. Spelter's quick rise had placed galvanized sheets temporarily at a prohibitive height, throwing more mills into the quest for light sheet business. On the other hand, the heavy gages were eagerly sought and the mills equipped to roll light plates were flooded with orders.

Gradually during the year the abnormalities in the situation began to disappear and some of the factors responsible for the market's unsteadiness began to exert an opposite influence. For instance, the absence of orders for sheets became of diminishing importance to those sheet mills which were operated as departments of large steel plants. The latter were inundated by orders for steel in other forms and at higher prices, and their sheet business became less desirable. By early fall the rise in the prices of other steel products had reached a point where sheet buyers were convinced of the permanence of higher quotations for steel, and they began to place orders. The buyers entered the market in great numbers and for large tonnages, only to find fewer manufacturers willing to take business. As a result, prices which had been somewhat artificially boosted by the advancing level of production costs, began to mount, due to a genuine demand. This condition grew stronger during the closing months of the year, sheet prices being carried to a level nearly 100 per cent


1914
1915
1916
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
DOLLARS PER TON
140 130 120 110 100 90 80 70 60 50 40 30 20 10
PITTSBURGH
GALVANIZED SHEETS
NO. 28 BLACK SHEETS PITTSBURGH
BLUE ANNEALED SHEETS PITTSBURGH
OPEN HEARTH SHEET BARS PITTSBURGH

PRICES OF SHEETS AND SHEET BARS, PITTSBURGH, 1914-1916

above that on which they entered 1916.

The raw materials of the sheet manufacturer advanced steadily in price during the year. Sheet bars rose to a height above the ordinary selling price of finished sheets, while labor costs increased greatly. Spelter, while falling off considerably from its highest point, remained well above its normal level. Deliveries of steel became increasingly uncertain, forcing some sheet mills on to part-time operations. The car shortage became a serious factor during the fall and exercised a restrictive influence. The coal situation threatened at one time to become serious, but gradually righted itself.

The sheet mills enter 1917 with little tonnage in stock. Many mills had carried large supplies of sheets in stock for years and took advantage of a fair demand in the middle of the year to clean out the last of this accumulated tonnage.

A change of great importance to the sheet industry was effected during the year by the adoption by most sheet manufacturers of a revised sales contract. The contract was advocated and accepted by the National Association of Sheet and Tin Plate Manufacturers, organized in the summer of 1916, and including in its membership 24 independent sheet and tin plate manufacturers. The contract provides for the payment to the sheet manufacturer of "liquidated damages", following the failure of a buyer to furnish specifications as contracted, and for the payment of damages to the seller if the manufacturer fails to ship the tonnage specified by the buyer under the terms of the contract. The object of the new contract is to reduce speculation on the part of both consumers and manufacturers.

The Trend of Prices

Black sheets, No. 28 gage, were quoted at 2.60c, Pittsburgh, in January, 1916, and at 4.75c to 5.50c in December, an increase of about 90 per cent.

Blue annealed sheets, No. 10 gage, were quoted at 2.40c, Pittsburgh, in January, 1916, and at 4.25c to 4.75c in December, an increase of about 90 per cent.

Galvanized sheets, No. 28 gage, were quoted at 4.75c, Pittsburgh, in January, 1916, and at 6.75c to 7.50c in December, an increase of about 50 per cent.

Sheet bars were quoted at $34 to $35 a ton, Pittsburgh, in January, 1916, and at $60 a ton in December, an increase of about 75 per cent.

Bundled sheet scrap was quoted at $14.50 to $14.75 a ton, Pittsburgh, in January, 1916, and at $16 to $16.50 a ton in December, an increase of about 10 per cent.

The past year has witnessed several anomalies in the sheet market. The greater demand for blue annealed sheets, early in the year, carried this grade to a higher level than black sheets, while for the same reason, in the east the heavier gages of tank plates sold at a higher figure than was was obtained for blue annealed sheets during the same period.

Tests on Failure of Brass

The Bureau of Standards recently has issued two interesting technological papers concerning tests made on the failure of brass. One of these is devoted to a description of an investigation made of the initial stress produced by the burning-in, without preheating, of constrained parts of castings of manganese bronze. The results have shown that, in general tensile stresses will be produced within the burned-in area, equal in value to the true elastic limit of the material. The conclusion is drawn that burning-in of such material should not be practiced without thorough preheating or subsequent annealing of the entire casting. The second booklet outlines a study which has been made of the effect of tensile stress on the electrolytic solution potential of brass to various solutions, the results indicating an increase of electro-motive-force of approximately 0.1 millivolts for 10,000 pounds per square inch of stress. An explanation is given, based upon this effect, of the decreased ductility and strength exhibited by brass when corroded while under tensile stress. The growth of fissure in brass under such conditions is also described. The two papers are identified as technological papers Nos. 84 and 93, respectively.

Plate Market Takes Leading Part

Ship Building at Home and Abroad Causes Tremendous Demand for Plates—Prices Advance to Very High Points—Railroad Requirements Extensive

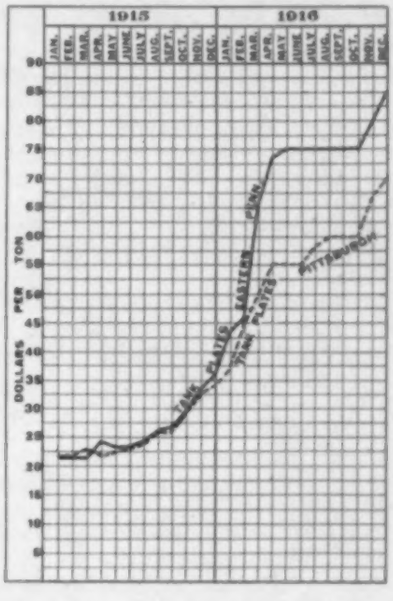
BY C. J. STARK

TWO principal sources of demand combined to make the plate market of 1916 the largest and most spectacular of all the heavy finished products. One of these, the world-wide activity in ship building, was an indirect though extensive result of the war and its ramifying effects upon international commerce, of which the remarkable rejuvenation of American maritime tonnage was only a part. The other, which developed more slowly and did not reach its height until the last half of the year, was the extensive additions and replacements made by the railroads to their rolling stock, both carrier and motive power. The railroad demand was, in large part, domestic development which was the outgrowth of the speeded-up industrial energies of the nation. Other classes of plate consumption contributed to the phenomenal strength of this product, but these two broad requirements of land and sea were paramount.

Of the two great factors in the year's plate market, that of ship yard needs was the most extraordinary. In every maritime nation of the globe the construction of new vessels was stimulated as never before by the shortage of ocean tonnage brought about by the ravages of war. Destruction, internment and utilization of ships for military purposes by the belligerent governments had created a great gap in the over-seas carrying facilities toward the filling of which feverish efforts in creating new tonnage were expended in many countries. The extent of these losses of war to peaceful trade, can be measured by the statement of experts that it will require a term of years for the construction of the world to replace the carrying capacity destroyed and to provide for the usual proportion of normal increase.

MANY of the nations which have set themselves to the task of rebuilding the world's commercial navies have lacked steel resources of their own to provide them with the necessary materials of construction. Shut off from Germany, Great Britain, Belgium and other great steel exporting nations of the ante-bellum days, they have turned to the United States as the only remaining major source of supply. Upon the plate mills of this country there has been directed a flood of foreign tonnage far beyond all precedent, which finally in connection with the tremendous demands of the greatly expanded American ship building industry, fairly has swamped capacity and has made the matter of price secondary to that of assured delivery. Japan, Italy, Norway, Spain, France and even Great Britain pressed for steel for the war needs of herself and of her allies, have been heavy and persistent buyers of American ship steel. This buying for home and foreign needs, as mill capacity has become clogged with orders, constantly has reached farther and farther into the future. As early as in March, it began to spread into 1917. It now is running at an increasing rate into 1918.

The plate tonnage bought and shipped in the year for merchant ships has been tremendous. In the United States alone, there were completed in 1916 from 140 to 150 steel vessels of perhaps 400,000 gross tonnage, while at least twice that number and capacity were under construction on Jan. 1, 1917. A number of these ships are for foreign owners. Norwegian shipping interests especially have been large customers of the American yards, adding to their orders of the previous year so that a score or more vessels were for their account. Of the 250,000 to 300,000 tons of plates exported



PRICES OF TANK PLATES, EASTERN PENNSYLVANIA AND PITTSBURGH, 1915-16.

in 1916, the large proportion went to foreign ship yards. On top of these heavy demands for merchant vessel construction, the United States government has called upon the mills for the material for the most pretentious naval program ever undertaken by any nation. This has required not less than 200,000 to 300,000 tons of rolled steel, the greater part of which is plates.

Car and Locomotive Orders

Car and locomotive orders placed in 1916 absorbed probably 1,000,000 tons of plates as a minimum. The total car orders placed with American builders, according to specially compiled statistics, were approximately 160,000, making it the largest year since 1912. Of these, about 100,000 were placed during the last five months, October and November contributing about 63,000. November was the banner month, with about 37,000. Foreign roads bought American cars in large numbers. Russia placed approximately 7,000 to 8,000; France, 6,000 to 7,000; Italy, 3,000; Cuba, 2,000, and there were many scattering orders. There are large blocks still in the market for Russia, France and other countries. The price of all-steel freight cars in the year advanced from about $1,200 to $2,000 each, chiefly because of the greatly increased price of steel which was the highest ever paid for this purpose. During the later part of the year, even the largest car builders were being charged 3.25c to 3.40c, Pittsburgh, on plates. These same buyers in earlier months had complained bitterly of 1.50c steel. The locomotives ordered in 1916 numbered more than 4,500, making it the greatest year since 1906. An unusually large number of foreign countries placed

business with the American builders. Russia bought 350 or more; France, about 500, including a small trench type, and there were important orders from Spain, Norway, Italy and South American countries. Russia still is a prospective buyer of 500 or more additional. Total car orders placed with American builders by months as compiled by *The Iron Trade Review* for the past several years are as follows:

	1916	1915	1914
January	21,700	2,500	13,000
February	12,900	4,000	9,000
March	8,750	1,100	7,500
April	7,000	1,500	10,000
May	4,155	18,000	6,000
June	1,300	17,000	15,000
July	2,600	9,500	7,000
August	15,025	3,000	1,100
September	15,500	9,000	100
October	26,000	22,500	50
November	37,000	11,500	500
December	8,000*	10,400	2,000
Total	160,000	110,000	70,250

*Estimated.

Bridge shops did not require plates on the same scale of tonnage as other leading consumers and this was reflected in the sluggish movement of universals in which conspicuously early deliveries could be made by the mills in contrast with those in wide tank and ship steel. There also was a considerable variation in prices. Until the latter part of the year when their large earnings induced them to undertake liberal betterments and replacements, the railroad bought bridge work in a moderate way. Continuation of New York City's elaborate program of subway and elevated extensions provided a need for a large plate tonnage. Industrial plant enlargements were another source of notable demand for construction purposes, boiler capacity increases, etc. The boiler manufacturers, especially the makers of marine boilers, enjoyed a very active year and their greatest problem was to get steel. The oil companies were the usual large buyers of tank plates.

Price Variations

As the year advanced and the new heavy demands for ship plates came in unceasingly upon the mills, the market sub-divided itself into one of districts and displayed a singular lack of price uniformity. These same characteristics had been manifested toward the close of the preceding year, but they were much more pronounced in 1916. Broadly speaking, there were two great branches to the market, one representing the activities of the eastern, and the other those of the Pittsburgh and middle western mills. Prices were highest where the preponderance of ship steel demand was greatest, which was in the east. The location of the eastern mills nearby the seaboard gave them a favorable position not only with respect to the Atlantic and Pacific coast ship yards, but to the export trade as well. Furthermore, they had specialized more or less in marine steel, hull and boiler, in the past. In January, eastern mills were quoting ordinary tank plates at 2c, Pittsburgh. Pittsburgh and Chicago mills at the same time were asking 1.80c, Pittsburgh. This spread of $4 a ton between the two territories grew as the year proceeded. At the end of 1916, the lowest plate price of the east was 4c, Pittsburgh, and that was limited to universals with certain mills, representing a minimum advance of $40 per ton in the year; the Pittsburgh and Chicago mill price for tank was 3.60c, Pittsburgh, a total advance of $36 a ton. The spread between the east and the west then was $8 a ton. During the first quarter the western price rose $16 per ton, while the eastern advanced $25. The second quarter added $3 in the west and from $5 to $10 in the east; the third quarter, $5 in the west and a firming up of previous maximums in the east. During the last quarter there was a uniform advance of $5 in both territories. A Chicago independent sold for the second quarter of 1917 at 4c, Pittsburgh, when the market for indefinite delivery was 3c, Pittsburgh. All mills received large premiums up to 5c and 5.50c, Pittsburgh, for quick shipments, especially on wide plates.

Ship Plates Vary Widely

This divergence of prices was much more marked in favor of the east in classifications other than tank plates. The minimum on sheared tank plates in the east on Jan. 1, 1917, was 4.25c to 4.50c, Pittsburgh. Ship plates, Lloyd specifications, were selling in east up to 5c, 5.50c and 6c, Pittsburgh, for deliveries running into 1918. Large western producers had been selling ship plates into 1918 at around 3.50c to 3.75c, Pittsburgh. The market in ship plates then, apparently, had become whatever the mill was inclined to ask, as buyers were offering practically any price for definite accommodation. Eastern makers had booked so large a proportion of tonnage where the exacting Lloyds specifications applied, that maximum outputs always could not be realized and for this reason they were led to differentiate sharply in their prices between ordinary tank and ship plates. A similar situation in marine boiler plates, according to the United States standards, was shown. The mills appealed to the government to modify its rigid requirements, but were successful in only a minor way. Those plants which rolled such plates made their prices fit the extra care and manufacturing detail required at a time when maximum plant outputs were desired most urgently. The result was that marine boiler plates, obtainable from only a few producers, commanded remarkable prices. From about 5c, Pittsburgh, per pound, they advanced to the extraordinary figures of 12.40c to 14.40c, Pittsburgh. Eastern plate mills, at the beginning of 1917, were sold up solidly for the first half, except on limited tonnage of universals; some of them could promise no quantities of size before the third and fourth quarters. The tightest condition was in ship plates. Leading Pittsburgh mills began the new year with ample orders for full operations well into the second quarter. A similar condition prevailed at Chicago. The mills of the latter district early felt the overflow from eastern plants. Even before this, strong pressure had been brought to bear on Chicago mills for plates to be used in ship building on the Pacific coast, for export to Japan and Russia, and later for car building.

Book Review

Practical Safety Methods and Devices, by George Alvin Cowee; cloth, 434 pages, 6 x 9 inches; published by D. Van Nostrand Co., and furnished by *The Iron Trade Review* for $3.00 net.

The business man of today accepts the fact that, both from a practical and a humane standpoint, measures for the prevention of accidents are a necessity. Industrial accidents cost this country the almost incredible sum of 35,000 human lives and $500,000,000 annually. In addition, dismemberments and other serious injuries total about 350,000 yearly, while the annual number of minor accidents, causing loss of time, exceeds 2,000,000. This statement does not include a very large number of cases of occupational diseases by which workers are either wholly or partially incapacitated, or which result in premature death.

Therefore a book which points out and explains means by which these accidents and diseases can be avoided is of great importance. The author shows where guards are needed and describes the different types of safety devices most applicable under given circumstances. Fire hazards and the best means of eliminating them are discussed. Safeguards necessary for use with machines in different kinds of factories are set forth and explained. Also methods and devices for accident prevention in the iron and steel industry, in handling and storing materials, in construction work, for steam and electric railroads, and in mining and quarrying operations are discussed. One hundred and twenty-eight illustrations accompany the text.

Domestic Demand for Steel Bars

Absorbs Larger Part of Production of American Mills, But Foreign Buying is an Important Feature of the Year—Cotton Tie Prices Highest in History of the Trade

BY G. H. MANLOVE

THE STORY of the steel bar market for 1916 is the story of the world market for steel. Soft steel bars entered into export business in large volume, for munition purposes principally, but also for ordinary use. Domestic demand has been huge and the world has sought to fill its steel needs in America.

Manufacturers of steel bars entered 1916 with orders on their books covering maximum capacity for six to ten months. By the end of January, one large western maker apportioned the remaining 1916 tonnage of its mills among regular customers, facing 11 months' business. At the end of this year, the same interest has sold its production practically through 1917, having on its books more than 12 months' business. Other makers can still give delivery in third quarter of 1917. Shipments have been deferred gradually throughout the year until now eight to nine months is the shortest time that can be obtained from the larger mills in the country. Though the export demand took tremendous tonnages, domestic demand absorbed by far the larger output of American bar mills, both in the steel produced and shipped in 1916 and in that sold for delivery in 1917.

During the first half of the year, foreign governments and domestic munition makers bought largely of rounds of bar mill size, 3¼ to 3½-inch diameters, for shrapnel manufacture. Most of this rolling was done on rail mills, rather than standard bar mills, and the production of standard sections was not affected materially by this large foreign tonnage, although it involved several hundred thousand tons.

The form of this demand changed later in the year as shells of larger caliber were demanded by warring nations, and it swung to large blooms. The greater portion of the year's buying was of the semi-finished product in 6-inch and larger sizes.

DOMESTIC users continued to buy freely through the year in the face of constantly rising prices, which seemed to have no effect in checking demand. Consumers of this as well as of other forms of finished steel apparently believed they must get on the books with their orders or they would be unable to obtain supplies for use in 1917. Producers willing to book ahead for indefinite delivery continued to do so practically until the end of the year, when they retired from the market temporarily with everything but a few specialties sold for 1917. Some independents remained out of the market for the latter third of the year and have sold nothing for last half of 1917. However, these all have a large tonnage sold for first half that will not be rolled until third quarter, their remaining tonnage being reduced by that degree.

The new year opens with many mills sold for the entire 12 months, others with a few months' production unsold, and a huge unsatisfied demand hanging over the market.

As usual, the Pittsburgh market set the pace for the rest of the country for the most part and eastern and western mills followed its lead in price making. Quotations on bar steel for delivery at convenience of the maker advanced $21 per ton in the first 11 months of the year. Of this advance, $13 was made in the first quarter of the year, from 1.85c to 2.50c, Pittsburgh. In the second quarter, prices remained steady and in the third quarter an advance of $2 was made on bars. In the final quarter, advance was more rapid and $8 per ton was added.

In the eastern territory, the advance from the beginning of the year was about $25 and in the west about $24 per ton.

During the second quarter, agricultural implement makers caused some excitement by efforts to obtain bars for last half delivery at less than the prevailing quotation, then 2.50c, Pittsburgh. They claimed this rate was ruinous and that they would be unable to sell their production at prices based on that cost for material. It was stated that some were able to obtain tonnage at 2.35c, but this later was denied. Implement makers bought in 1915 at 1.20c and early in 1916 at 1.90c.

Bar Iron Prices

BI-MONTHLY SETTLEMENTS SHOWING AVERAGE PRICES OF BAR IRON.

	1913.	1914.	1915.	1916.
Jan.-Feb.	1.4831c	1.1590c	1.024c	1.40c
Mch.-Apr.	1.5434c	1.1760c	1.05c	1.60c
May-June	1.5272c	1.1257c	1.10c	1.85c
July-Aug.	1.5029c	1.0928c	1.15c	1.95c
Sept.-Oct.	1.3931c	1.0847c	1.20c	2.00c
Nov.-Dec.	1.2030c	1.037c	1.30c	....

ANNUAL AVERAGE OF SETTLEMENTS.

1915	1.137c
1914	1.1843c
1913	1.4421c
1912	1.2645c
1911	1.2598c
1910	1.4423c
1909	1.360c
1908	1.386c
1907	1.627c
1906	1.587c

Bar Iron Advances

Bar iron advanced fairly uniformly $18 a ton through the year in all markets. At Pittsburgh it rose from 2c to 2.90c; in Philadelphia the advance was from 2.259c to 3.159c; at Chicago it moved from 1.75c to 3c, a gain of $25 per ton. At Philadelphia at the beginning of the year bar iron was $5 per ton above steel bars. Later this condition was reversed and at the close of the year they were on the same basis.

Bar iron sales sheets examined bimonthly by mills identified with the Amalgamated Association of Iron, Steel and Tin Workers show the actual price averages during the year:

January-February	1.40c
March-April	1.60c
May-June	1.85c
July-August	1.95c
September-October	2.00c

Prices for the final two-month period will not be available until later this month. Wages for puddlers advanced from $6.90 to $9.55 a ton for boiling, the latter price being the highest ever paid in the history of the craft in this country.

Hard steel bars followed the general upward trend of soft steel through the year. Chicago mills advanced prices from 1.80c to 3c, Chicago. Much of this advance was on account of the high cost of material, rerolling rails having advanced to levels above the original cost of

the new rails. Use of this material in place of soft steel in many places where the substitution was possible added to the demand. In the east, crops from shell steel were utilized for rerolling into hard bars and considerable tonnages were made from this source.

Scarcity of Hoops

Consumers found it almost impossible to buy hoops in 1916 for delivery in less than 60 days. The Carnegie Steel Co. could not meet specifications for shipment in less than from nine to eleven months and other manufacturers occupied about the same position. Prices of steel bands closely followed those of steel bars during the entire year. Steel hoops were offered on the steel plate basis until the fourth quarter of the year. Steel hoops advanced $25 a ton in the first 11 months of 1916. At the opening of the year, they were offered at 2c; during the first quarter, they advanced $15 a ton and advances of $5 each were registered the third quarter and the first two months of the fourth quarter. For anything like prompt delivery, some mills obtained premiums ranging from $5 to $15 per ton.

Insistent demand for screw stock and shafting featured the market throughout the year just ended. Cold rolled steel shafting makers offered material at 45 per cent off the list at the opening of the year, but advanced the price to 20 per cent off the list by July 1, last. Rather heavy tonnages, for shipment the first and second quarters of 1917, were sold at from 21 to 10 per cent off the list, or from $30 to $35 a ton above the prevailing price 12 months ago. Some shafting makers followed extremely conservative sales policies, owing to the uncertainty of the market for steel bars. At least one mill was able to meet specifications for delivery within 60 days at the close of 1916.

Cotton Ties High

The market for cotton ties for 1916 delivery was opened at Pittsburgh, June 26, at $1.35 a bundle of 45 pounds, July basis. The 1916 price was 50 cents above the 1915 quotation and was the highest to prevail in the history of the cotton tie market. Three-quarters of a cent was added each month for deferred shipment, as against the previous extra of ½-cent a bundle. The Carnegie Steel Co., Pittsburgh; the Pittsburgh Steel Co., Pittsburgh; the Conners-Weyman Steel Co., Birmingham, Ala., and the Atlanta Steel Co., Atlanta, Ga., furnished virtually all the cotton ties used last year. The entire production was estimated at about 50,000 tons, 30,000 tons of which were furnished by the Carnegie company. The Sharon Steel Hoop Co., Sharon, Pa., did not figure in the market, although equipped to roll ties.

The 1916 cotton crop, which ran between 12,000,000 and 15,000,000 bales, required about 500,000 tons of ties.

The following table shows the season's prices per bundle of 45 pounds since 1901:

Prices of cotton ties, per bundle.

1901	$0.72	1909	$0.70
1902	.80	1910	.75
1903	.85	1911	.75
1904	.75	1912	.70
1905	.85	1913	.80
1906	.85	1914	.65
1907	.95	1915	.85
1908	.85	1916	1.35

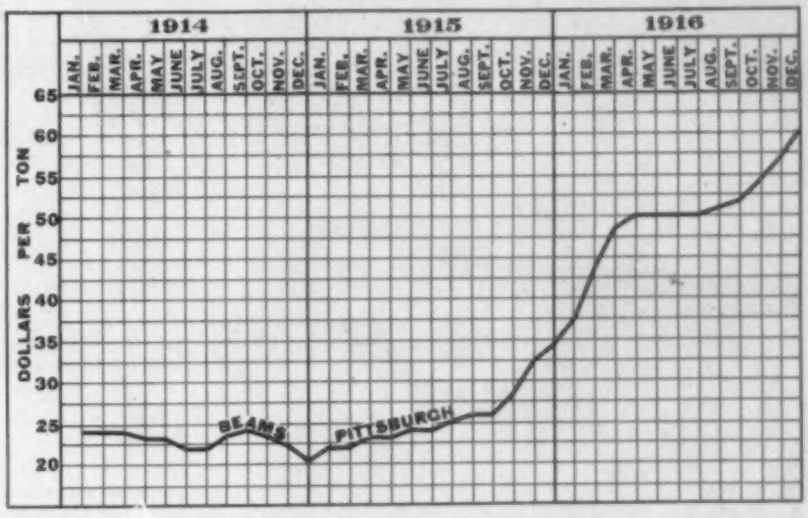
New Plants Demand Large Tonnages

WHEN the production statistics of 1916 are compiled, it probably will be found that the output of structural shapes in the United States did not maintain its normal proportion of the year's unprecedented increase in finished rolled steel. There has been little of similarity of the conditions in shapes with those which made the year a remarkable one in plates. Yet the shape market has recorded the highest prices in its history and throughout the past 12 months, constantly has given an exhibition of great strength. That this has been so, has been for the same cause, apparently, that has made the year a banner one for every line of rolled steel, namely, the limitations of ingot capacity. With a place in some form for practically every ton of metal that the steel works could produce, much tonnage which normally might have gone to the shape mills has been directed into products where the profits to the manufacturers have been much more lucrative. This has operated to restrict the tonnage available for the rolling of shapes; similarly, it has placed an intrinsic worth on raw steel that has fixed the high prices in shapes, the same as it has done in other finished materials of that class, less favored in the year's remarkable war and export demand. There have been signs that some of the makers with a wide assortment of finished products have been inclined to rate shape orders as among the least attractive under the peculiar conditions of trade that have obtained.

THE year of 1916 has been barely an average one in the volume of building work that relates to structural steel demand. The gross awards of this kind to fabricating shops have been only approximately as great as during the preceding year, according to the official statistics compiled by the Bridge Builders' and Structural Society. They totaled about 1,460,000 tons, equivalent to approximately 70 per cent of the country's fabricating capacity.

The tonnage placed in 1916 has not been of a general character. It has been drawn largely from the requirements of a period of great industrial expansion. It is doubtful whether any single year in a decade, if ever, has shown so many and extensive enlargements of capacity of plants engaged in heavy manufacturing lines. The direct iron and steel industry itself has furnished a notable demand of this kind. Munition, ship building, machinery and various other types of works under the drive of great prosperity, have figured heavily in the year's tonnage. This has been business of a preferred class since their own large profits currently realized have made these buyers willing and anxious to pay whatever prices have been necessary to serve their needs of increased capacity within a minimum of time. Until the latter part of the year, when they released liberal amounts of bridge work and other line improvements, the railroads were not broadly active as buyers of structural tonnage. Nevertheless, they furnished a good percentage of the year's awards. In ordinary commercial work, a spotty condition has been shown. Many projects have been carried forward without delay. In a greater number of cases, however, the high cost of construction has been an effective deterrent and has kept these undertakings in abeyance until conditions shall become more favorable. This has been true especially in the larger cities in structures both of an investment and speculative character, where a fixed rate of return on the outlay is the controling factor. Many smaller enterprises of a miscellaneous character and a large amount of public work also have been held back. It

is evident that a large volume of building work has been backing up in the country during the past year awaiting times more propitious for its being carried through. This is a favorable circumstance for later days, when the steel industry shall have returned from its present feverish prosperity to more normal conditions. The completing sections of New York City's large rapid transit extensions were placed during the year and these amounted to probably 100,000 tons. Exports of shapes were heavy and were approximately 275,000 to 300,000 tons, which were substantially the same as 1912. The French government, through J. P. Morgan & Co., was a large buyer of beams and channels, presumably for trench construction. These orders approximated 50,000 to 75,000 tons. Contract shapes began the year of 1916 at 1.85c, Pittsburgh. Eastern mills then were asking from 1.90c to 2c, Pittsburgh. The advance in the first quarter was large, amounting to $13 a ton, so that on April 1, beams were selling at 2.50c, Pittsburgh. They remained very steady at this price for about four months until in August a general advance of $2 a ton was made, which was followed by another of an equal amount late in September to 2.70c, Pittsburgh. During the last quarter, the rise of prices was more rapid, there being new advances of $6, of which $2 came in October and $4 in November. At the year's close, prices were 3.10c, Pittsburgh, in the Pittsburgh and Chicago districts, and from 3.25c to 3.50c, Pittsburgh, in the east. Eastern Pennsylvania mills which roll shapes exclusively profited greatly from the overflow of tonnage from western mills which did not seem so anxious for shape tonnage. The eastern producers during a large part of the year kept ahead of the Steel Corporation schedule. This was especially marked during the last quarter of the year. Ship shapes from eastern mills brought good premiums over the base for standards, ranging from $5 to $10 per ton. Fabricated prices were irregular throughout the year, which was a logical outgrowth of the rapid advance in plain material prices. This gave the shops a wide margin of profit on shipments of plain material under contracts previously made and in many cases this was divided with the customer, especially where the competition was close. At the year's close, ordinary work was commanding from $90 to $100 per ton, erected. The producing capacity of the shops was restricted considerably during the year by short and inefficient labor, delays in shape deliveries, car shortages, etc. The warehouses did a big business in shapes, especially with the smaller fabricating trade, because of deferred mill shipments. Some of these buyers were obtaining fully 50 per cent of their requirements from jobbers toward the close of the year. Some of the shape orders placed with the warehouses were unusually large and there were single purchases up to 1,000 tons. The tonnage of structural steel lettings in the United States by months during the past three years, as compiled by the Bridge Builders' and Structural Society, is given as follows:



PRICES OF BEAMS, PITTSBURGH, 1914-1916

	1916	1915	1914
January	119,000	43,000	110,000
February	129,000	51,000	105,000
March	175,500	110,000	130,000
April	125,000	107,500	150,000
May	137,000	105,000	100,000
June	100,000	138,000	95,000
July	83,600	148,000	115,000
August	110,000	146,000	50,000
September	99,000	115,000	65,000
October	133,500	134,000	60,000
November	134,000	180,000	35,999
December	125,000*	208,000	60,000
Total	1,460,600	1,485,000	1,075,000

*Estimated.

A. S. Blagden has been elected president of the American Malleables Co. in place of W. G. Pearce, who has been made chairman of the board. The American Malleables Co. has plants at Lancaster, N. Y., and Owosso, Mich., and specializes in malleable iron automobile castings.

Knocking Out a Billion Dollar Loss

(*Concluded from page* 11)

the ancient privilege of talking it over with the boss. If the man below has no chance to communicate his desires, feelings and aspirations to the man above, misunderstandings are sure to arise that eventually may breed civil war on a minor scale. To prevent a repetition of conditions found to exist in 1913, the Colorado Fuel & Iron Co. has adopted a broad industrial welfare plan, aptly termed an industrial constitution, that gives even the humblest pit worker a chance to be heard. Radical in many of its provisions, the Colorado plan has so far worked admirably. Its details would be well worth close investigation by executives of large corporations such as those controlling the major portion of the steel output of the country. The necessity for widespread, effective vocational training is now so generally recognized that it requires no supporting arguments. It is a prime factor in the permanent solution of the labor problem. Low wages result from the incapacity of unskilled workers, and such wages are the strongest single influence making for discontent. The need for vocational training is self-evident. What is wanted now is action. Satisfactory training schools will never become general until demanded in no uncertain tones by industrial managers. To give an inkling of the tremendous task involved in satisfactorily working out this one phase of the general labor problem, the requirements for the skilled operation of a single machine-shop tool—the ordinary engine lathe—are presented on page 11 accompanying this article.

Finally, and this applies with special emphasis to the iron and steel industry, to secure the permanent elimination of our labor ills, our foreign workers must be Americanized. Now, while immigration is cut off, we have a glorious opportunity to make up for past neglect in this direction. The processes of assimilation should be speeded-up by energetic employers and the melting pot set to boiling. Few communities are yet awake to this vital need. Detroit, under the able direction of its Executives' Club, has made greater tangible progress

toward the Americanization of its unleavened foreign lump than any other great industrial center. Complete cooperation has been secured between the city's industries and its great system of public evening schools, with the result that the English-speaking population of the automobile city is increasing by leaps and bounds.

The enthusiasm of Detroit's industrial leaders over the results of the Americanization campaign knows no bounds. Alvan Macauley, president of the Packard Motor Car Co., in an interview published in *The Outlook*, struck the keynote when he said:

"The most important thing about this Americanization of foreign workmen is that it promotes industrial peace. It has been a hard blow to the padrone system. When our men have grievances now, they are able to come to us and tell us about them, instead of going to a dishonest boss of their own nationality, who fans the fire for his own ends. This work produces unity and teamwork in the shop. That is its most important benefit. It leads to teamwork."

And, unconsciously perhaps, Mr. Macauley has put his finger on the crux of the whole labor situation. The final end and aim of all labor plans, for Americanization, industrial peace, vocational education, improved earnings, bonuses, increased efficiency and what not may be summed up in that single word—*teamwork*.

Further advances of $4, in shapes, to a basis of 3.95c, delivered, and $2, in steel bars, to 3.85c, delivered, have been made in New York warehouse prices.

Outlook Good

For Near Future, Says Gary—Labor Demands Not Unfair

New York, Jan. 2. (By wire.)—Judge Gary, in a brief published statement, says the outlook for business in the early months of the new year is good and equal to that of the last half of 1916. He believes the end of the war will not mark the end of the present prosperity, but looks for reaction and material diminution soon after peace. He says about half of the country's trade, both domestic and foreign during the past year, has been due to the war.

He does not think labor's demands here exceeded a fair share of the increased profits but states it is doubtful whether present wage rates can be maintained.

New Partners in M. A. Hanna & Co.

M. A. Hanna & Co., Cleveland, announce that H. M. Hanna Sr. has retired from partnership in the firm and that F. B. Richards, William Collins and R. F. Grant have become firm members with the remaining partners, L. C. Hanna, R. L. Ireland, M. Andrews and H. M. Hanna Jr. Mr. Richards has been identified with the firm since 1893 and long has been in charge of pig iron and iron ore sales. Mr. Grant is counsel for the company and Mr. Collins is in charge of the coal sales department.

An inquiry sent out by a Cleveland buyer for 40,000 tons of steel pipe has not been filled, as no deliveries could be secured except for the latter part of 1917. The order called for 2, 3, 4, 5 and 6-inch pipe divided in about equal amounts in the 40,000 tons. The buyer has abandoned the inquiry on account of inability of steel companies to make satisfactory deliveries.

Active Buying

By the Railroads—New Orders for Cars and Rails

New York, Jan. 2.—Activity in the buying of equipment by the railroads is well maintained as the new year begins. The Baltimore & Ohio railroad has ordered 1,000 hoppers from the Pullman Co.; the Norfolk & Western, 1,000 box of the Mount Vernon Car Mfg. Co. and the Union Pacific, 2,500 to 3,000 box and refrigerator types, of which 1,800 will be built by the American Car & Foundry Co. and 600 to 700 in the company's own shops. The Russian government railways have distributed an additional 3,500 cars of the smaller four-wheel type, the business going to the Eastern Car Co. of Nova Scotia. The Virginian railway has out a new inquiry for 1,000 hoppers. The Pressed Steel Car Co. has received orders for 1,600 cars for the San Pedro, Los Angeles and Salt Lake railroad.

The Pittsburgh & Lake Erie railroad has ordered 10,000 tons of rails for 1918 of the Carnegie Steel Co. The Union Pacific has ordered 32,000 tons of the Illinois Steel Co. Of the Erie's order of 35,000 tons, 10,000 tons went to independents.

Prices Present and Past

(Yesterday, a month ago, three months ago and a year ago.)

Quotations on leading products January 3, average for December, 1916, average for October, 1916, and average for January, 1916. Prices are those ruling in the largest percentage of sales at the dates named.

	Prices Jan. 3, 1917.	Aver. for Dec., 1916.	Aver. for Oct., 1916.	Aver. for Jan., 1916.
Bessemer pig iron, Pittsburgh	$35.95	$35.95	$24.325	$21.32
Basic pig iron, Pittsburgh	30.95	30.95	24.825	19.20
No. 2 Fdy., pig iron, Pittsburgh	30.95	31.70	21.075	19.95
Northern No. 2 Fdy., Chicago	30.00	29.25	19.13	18.50
Lake Superior Charcoal, Chicago	33.75	32.00	20.40	19.25
Malleable, Chicago	30.00	29.25	19.50	19.00
Southern No. 2, Birmingham	23.00	23.00	15.13	14.50
Southern Ohio No. 2, Ironton	30.00	30.00	19.38	18.00
Basic, eastern Pa.	30.50	30.00	21.00	19.50
No. 2X Virginia furnace	26.50	26.00	18.50	17.25
No. 2X foundry, Philadelphia	29.50	29.50	20.50	19.75
Ferro mang., Balti.	164.00	160.00	160.00	110.00
Bessemer billets, Pbgh.	60.00	58.75	45.75	33.75
Bess. sheet bars, Pbgh.	60.00	58.75	45.75	33.75
Op.-h'th sh. bars, Pbgh.	60.00	58.75	45.75	34.75
Open-hearth billets, Pbgh.	60.00	58.75	45.75	34.75
Steel bars, Pittsburgh contract	3.00	2.925	2.60	1.86
Steel bars, Chgo.	3.19	3.10	2.80	2.03
Iron bars, Philadelphia	3.159	3.059	2.659	2.259
Iron bars, Cleveland, local del'y.	3.00	3.00	2.55	2.00

	Prices Jan. 3, 1917.	Aver. for Dec., 1916.	Aver. for Oct., 1916.	Aver. for Jan., 1916.
Iron bars, Chgo mill	$3.00	$2.85	$2.35	$1.83
Beams, Chgo. contr.	3.29	3.20	2.80	2.03
Beams, Pittsburgh, contr.	3.10	3.025	2.70	1.86
Beams, Philadelphia	3.409	3.409	2.859	2.159
Tank plates, Pbgh., contract	3.60	3.525	3.00	1.87
Tank plates, Chicago, contract	3.79	3.75	3.19	2.05
Tank plates, Philadelphia	4.159	4.159	3.909	2.409
Sheets, blk., No. 28, Pbgh.	5.00	4.50	3.225	2.58
Sheets, blue anl., No. 10, Pbgh.	4.50	4.00	3.125	2.45
Sheets, galv., No. 28, Pbgh.	7.00	6.25	4.45	4.75
Wire nails, Pittsburgh	3.00	3.00	2.62	2.12
Connellsville fur. coke, contr.	5.00	4.44	3.37	2.50
Connellsville fdy. coke, contr.	6.00	6.00	4.87	3.75
Heavy melting steel, Pbgh.	24.00	25.00	17.87	17.37
Heavy melting steel, eastern Pa.	23.00	24.00	15.75	16.75
Heavy melting steel, Chgo.	23.50	23.37	16.50	15.50
No. 1 wrought eastern Pa.	28.00	27.00	22.00	22.25
No. 1 wrought, Chgo.	25.00	25.37	17.50	15.50
Rerolling rails, Chgo.	28.50	29.50	18.75	17.70
Car wheels, Chgo.	22.00	21.87	12.25	14.75

(For Additional Prices See Pages 120 and 122.)

Trumpet Call to All Business Men

To Co-operate With the Government by President Jas. A. Farrell, Who Tells How Foreign Trade Can be Held by the United States—Exaggerated Idea of Extent of Export Trade During the War

BY JAMES A. FARRELL
President of the United States Steel Corporation

LOOKING back over the year 1916 and its important increase in our foreign commerce, there is cause for encouragement and hope that much of the progress made is of a substantial character. The year's development of foreign commerce has carried the total volume of exports to the impressive figure of $8,000,000,000 and indicates that the American public is beginning to realize the vital importance of foreign trade in domestic prosperity. The corollary of the situation is to be found in the greater attention that the country is giving to the problems of international commerce. Full appreciation is being shown that the conditions which will obtain in the world's markets after the European war are important to all citizens, to all sections and to every branch of business enterprise.

The emergency created by the outbreak of the war was effectively met by governmental and business co-operation and co-operative effort has characterized much of the extension of our foreign trade during the last two years. The belligerents have employed co-operation for war purposes with results which every foremost economist urges should be applied to private industry during the period of recovery from war, and probably as a permanent policy thereafter.

Important New Agencies

In the United States, the general desire for the development of a sound national foreign trade policy has borne fruit. Practically every important commercial and industrial organization, each of which represents the desire of business men collectively to serve the public welfare, had addressed itself to some phase of foreign trade activity. As a result of this and other forces, the government now possesses certain new agencies which are, or can be made, useful to foreign trade, while old agencies are giving greater attention to the needs of oversea commerce. These agencies are:

1—Department of commerce.
2—Federal trade commission.
3—Federal reserve board.
4—United States shipping board.
5—United States tariff commission.

Each has by statute certain functions to perform relative to the foreign trade. Certain of these functions are merely investigatory in character, but designed to yield authoritative information necessary for legislation in the interest of foregn trade.

The federal trade commission, by investigation has established the necessity for co-operation among American exporters along lines pursued by their competitors, and the legislation which is expected as a result of the commission's recommendations, should permit a much larger number of American industries, especially those of moderate size, effectively to engage in foreign trade, and obtain the benefit of foreign markets as a safeguard against recurring periods of domestic depression.

These changes may be expected to extend to shipping policy, following the creation of the United States shipping board, the largest function of which, according to the act of congress, is to recommend the measures necessary to permit a sound development of the American merchant marine.

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JAMES A. FARRELL

Sound National Policy

The effectiveness of these commissions and boards in developing a sound national foreign trade policy depends first upon the intelligence and independence of their personnel and, then, above all, upon the co-operation of business men. The laws establishing them all contemplated their close association with American business enterprise, which is dealing with the daily problems of exporting and importing, ocean transportation and banking. If business men will collectively give their best thought to the solutions of the difficulties which have arisen, and will arise in foreign trade, practical recommendations can be presented to the government to form the basis of national policy. The problems of foreign trade are national in character and their solution lies beyond the influence of any group or small number of groups. The future welfare of the nation's foreign commerce largely depends upon the participation in its benefits of an increasing number of industries of moderate size, as well as the safeguarding of interests already established in oversea commerce.

The iron and steel industry has shared liberally in the year's export trade and shipments of this character will exceed 6,000,000 tons, or practically double those of any previous year. The great expansion of our foreign trade in iron and steel has been affected in an important way by the war, which practically has shut off Germany from all neutral markets wherein she formerly was powerful; has placed all the iron and steel works of Belgium, a great exporting nation before the war, as well as the largest industrial districts of France, in a position where consumers in neutral markets have come for supplies to the United States. An exaggerated opinion has been held by a considerable part of the public, however, as to the portion of the year's export trade which has been furnished by shipments of munition steel. Probably not over 25 per cent of the year's exports has been of this character.

Intelligent Co-operation

In my opinion, with intelligent co-operation both among business men themselves and between them as a class and the government, this country should be able to retain permanently a large part of the export trade gained during the past year. The problem of meeting the conditions after the war is purely an economic one. It will turn chiefly upon the comparative costs of production in this country and Europe. So many factors affecting manufacturing operations and production have become prominent under war regimes that the relative importance of the human factor in the future may not be appraised with assurance. Increased efficiency has grown out of the war in every country participating, and a closer union of governments and private business. Underlying all the competition after the war by the belligerent nations will be the necessity of recouping their resources in every way possible and this necessarily must come through fresh capital gained by trade beyond their boundaries.

As a nation we should approach the conclusion of the war better qualified to do a foreign trade comparable with our industrial potentialities than ever before. A greatly increased number of our business men have gained valuable experience in overseas trading and have been made familiar with the conditions and problems under which it is conducted; our banking facilities have been extended and adapted to export transactions; our shipping tonnage is growing; and, most of all, the general public has been aroused to the necessary importance to general prosperity of foreign trade, especially in view of the wide extension of our manufacturing capacity in recent years. These circumstances, if properly taken advantage of, assure a creditable future to our foreign commerce.

THE OPEN HEARTH

Record of a Marvelous Year in Charts—New Peaks Tower Above High Points of the Past

THE graphic method of presenting facts in connection with the reviews of the year is adopted in this issue of *The Iron Trade Review* to a greater extent than ever before. This method is particularly impressive at the present time on account of the wonderful record of the past year. Until 1906, the peaks on the price chart which stood out most prominently were those of 1895, 1899 and 1902. Even the mountain showing that the prices of tank plates was a shade above $65 in September, 1899, has been eclipsed by tank plates, Chicago, $10 higher, in December, 1916, and with plates quoted still higher in Philadelphia. In pig iron, it is interesting to note that the line indicating prices of bessemer pig iron was never above $25 in the entire period of 22 years covered by the charts except for a very short time in 1899, when the $25 point was exceeded by 50 cents, and for a few weeks at the close of 1916. We called attention last year to the fact that the highest peaks of the past had sharp points, showing that declines come quickly when very high prices are recorded, but there is nothing at present to indicate sudden declines and it may be that a high plateau or rolling mountain will appear on the charts of the next two or three years.

On one supplement are printed two charts, showing fluctuations of prices during a period of 22 years. These prices on products are as follows: Tank plates, Chicago; bar iron, Cleveland; bessemer billets, Pittsburgh; bessemer pig iron, Pittsburgh; No. 2 foundry, Chicago; gray forge, Cincinnati; No. 2 foundry, Birmingham, and steel bars, Pittsburgh. A new colored chart is added, showing fluctuations over the years 1914, 1915 and 1916, on No. 28 black sheets, Pittsburgh; tank plates, Philadelphia; basic pig iron, eastern Pennsylvania; silvery 8 per cent silicon pig iron, southern Ohio furnace, and heavy melting steel, Pittsburgh.

The solid and broken lines traversing the diagram indicate the prices at which the largest percentage of the tonnage was placed, but do not show the highest or lowest prices at which some of the tonnage was sold. If prices for prompt delivery were shown, very much higher quotations would be indicated.

The lower chart shows the very short-lived boom in 1895, which followed the period of depression; then the decline in the latter part of 1895, followed by the slow general decline of 1896 and 1897, when in mid-summer the lowest prices on record prevailed; the rather steady trend of prices from the middle of 1897 to the fall of 1898; the rapid rise at the close of 1898, followed by the very high quotations of the boom year, 1899; the sharp decline beginning in September, 1899, and continuing until the mid-summer of 1900; a partial recovery at the close of 1900; and the continuance of prices upward during 1901; the rapid advance during the first half of 1902 and sharp decline beginning in the fall of 1902 and continuing during 1903, followed by a long period of prosperity, with occasional recessions, ending suddenly in October, 1907, with the panic of that period.

Owing to the co-operative policy which prevailed in 1908, there was more regularity in prices than would have prevailed without it, but following the declaration of the open market in 1909, prices declined rapidly. Upward tendency marked the last half of the year, but in 1910 prices again declined and the downward tendency continued through 1911. Recovery was not well under way until June, 1912, but the last of that year recorded decided gain. In 1913, weakness developed in pig iron early in the year and this extended to finished materials, so that by July 1 the downward trend was marked. The year 1914 was one of weakness in prices and general business depression, but owing to the low level which prevailed at the close of 1913, the prices at the close of 1914 were not much lower than at the beginning of that year. In pig iron, especially, the chart for 1914 is remarkable in showing smaller fluctuations than in almost any twelvemonth during the 22-year period. In 1915, finished materials felt the stimulus of improved demand early in the year. The prices of pig iron were almost stationary up to July 1. During the last half of that year, price advances were rapid, especially in the last quarter, in both finished materials and pig iron, and while the upward tendency continued almost unbroken throughout 1916, it was, like that of 1915, much more decided during the last quarter of the year.

On another sheet published as a supplement, charts show average monthly prices at ovens of Connellsville furnace coke for prompt delivery, from 1900 to 1916, but it should be noted that as the prices are the average for the month, the extremely high quotations which prevailed during the latter part of December are not indicated; production of coke and anthracite pig iron in the United States from September, 1907, to Dec. 1, 1916; unfilled tonnage of the United States Steel Corporation from 1910 to November, 1916; net earnings of the Corporation from 1902 to the last quarter of 1916, and shipments of Lake Superior iron ore from 1872 to 1916.

The market reviews are embellished this year by

THE OPEN HEARTH

an unusually large number of charts, which we believe will be found remarkably interesting. These include charts showing fluctuations in warehouse prices at Cleveland from 1909 to 1916; of leading grades of scrap in the Chicago district during the past three years, and of numerous other products.

Last year, for the first time, *The Iron Trade Review* published a chart showing fluctuations of non-ferrous products, and this year a more elaborate chart is published as a supplement. Some of these products are very closely connected with the iron industry, and for this reason lines showing prices of tin plate and galvanized sheets are included in the non-ferrous chart.

Harmony Must Prevail

IN LOOKING forward to the period after the war and trying to decide what will happen, men differ widely as to the best methods of meeting in future years the competition of the nations now at war. On one point, however, there can be no difference of opinion; that is, there must be harmonious relations between capital and labor.

If employers and employes are to fight each other, they will not be in a position to fight for the commerce of the world.

In the last analysis, the solution of the problems which vex employer and employe depends upon whether the spirit of reasonableness and fairness prevails. We believe that the most important object for which the men of this nation can strive is to bring about the reign of that kind of spirit.

In this connection, we wish to call attention to the article in this issue entitled, "Knocking Out a Billion Dollar Loss". It is not only intensely interesting, but abounds in sound suggestions in regard to solving labor troubles. Read it—every word of it.

Bury Vituperation With the Year

EXCESSIVE use of abusive language has been growing in popularity among some people in this country in recent years. The slogan of many seems to be, "If you don't agree with a man, call him names." During the recent presidential campaign, the man who apparently aroused the greatest enthusiasm was Ex-President Roosevelt, who used more violent language than any man approaching him in prominence, while Mr. Hughes was subjected to much criticism because his speeches were dignified and moderate in expression, although not at all lacking in vigor. In another field of activity, Billy Sunday has a vast number of admirers who glory in his sensational methods and declare that, even if he is vindicative and abusive, he gets results.

The beginning of the new year is, we believe, a fitting time calmly to inquire whether it is not possible to fight like a gentleman—vigorously, but with willingness to concede the honesty of purpose of those with whom one does not agree. We believe that such a course is not only possible, but is demanded by the highest considerations. Evidence that the methods of Roosevelt and Sunday are as effective as their admirers have claimed is lacking. On the contrary, some states to which the ex-president gave a great deal of attention, as, for example, Ohio, were swept by Wilson and there is strong testimony from western states that the Roosevelt speeches harmed the cause of Hughes. It is also true that the result of the recent election in Boston on the liquor question was a decisive defeat for the sensational evangelist.

In the name of decency, self-respect and regard for the opinion of others, let everybody bury vituperation with the old year and make the new year notable for saner methods.

Will They Have the Courage?

A DETERMINED effort was made the past year to frame an iron clad contract which would be enforceable with the market declining as well as at other times. The American Iron and Steel Institute took an important part in the agitation, but the most positive action was by the National Association of Sheet and Tin Plate Manufacturers in adopting a contract in harmony with the tentative views of the directors of the institute. At the recent meeting of the association, T. D. McCloskey, one of its attorneys, discussed the new contract at length, asserting that it is fair to all concerned, the language is plain and imperative, and that the plan for the payment of substantial damages in the case of default is a strong feature.

"The condition," said Mr. McCloskey, "has become intolerable. The legal mind views the situation with astonishment. The federal trade commission was 'amazed' when informed of the way in which steel has been sold under alleged contracts. As a result of it all, you individually find yourselves helpless, impotent, confronted by persistent, possibly unscrupulous, buyers; suspecting your competitors, you are unable, except by concerted action, to restore your business to a condition of real, open and fair competition."

The contract has indeed the appearance of a rigid document, but, after all, the question will be whether, if the market declines sharply, the seller will have the courage to insist upon the enforcement of the terms, thereby possibly incurring the ill will of the customer.

Have We Too Many Steel Furnaces?

**The Country's Steelmaking Capacity is Now the Greatest in History—
Is This Expansion, Made During the War, Justified by
the Prospects for Future Business?**

WARTIME prosperity has robbed the American steelmaker of confidence in his ability as a prophet. Flooded by a rising tide of orders that surpasses anything in his past experience, harrassed by buyers to a degree previously unknown, encouraged by the highest prices in contemporary commercial history and vexed by the opportunities to increase profits lost through inadequate capacity, the steelmaker is perplexed by the lack of precedents to which to cling. With money in his pockets and orders on his desk, he has felt justified in broadly extending the capacity of his plant and that is what he has been doing. But all the time he has had the feeling—which at various times is a conviction, a fear and a belief—that after the war boom is over there will be more steel plants than the country can support.

One of the leading figures in the American steel industry remarked a few days ago, that in unprecedented times like the present, there was but one immutable factor upon which he could rely as he faced his day's work. That factor was the law of supply and demand. Although apparently quashed at present when the heavy demand has tipped the scale beam from horizontal to almost a vertical position, the law, this steelmaker pointed out, is as certain as the sunrise; either the supply will overhaul the demand, or the demand will diminish until the balance is re-established.

Thus stated, the problem of deciding whether

Open Hearths Built Since War Started

In the United States and Canada during the first 28 months of the war—Aug. 1, 1914 to Dec. 1, 1916—the construction of 257 open hearth furnaces was either completed or begun. Steelmaking capacity added during the war has thus averaged nine furnaces a month. Of the total, 236 furnaces are in the United States and 21 in Canada. Basic open hearth furnaces increased by 225 and acid open hearths by 32.

The new basic furnaces have a rated capacity of 14,893 tons, or 34 per cent of the total American and Canadian capacity when the war broke out. The new acid furnaces have a rated capacity of 975 tons, or 26 per cent of the total American and Canadian capacity when the war started. In number, the increase in basic furnaces is 29 per cent, and in acid furnaces, 19 per cent. In addition to the furnaces included in the foregoing figures, 94 open hearth furnaces are now proposed.

The following table shows, by districts, the capacity and number of basic and acid furnaces before the war; built since Aug. 1, 1914, or now building; the percentages of increase; and the companies which have built new furnaces:

	Prior to Aug., 1914				Built or Building Since Aug. 1, 1914				Per Cent Increase			
	No. of Fcs.		Capacity		No. of Fcs.		Capacity		No. of Fcs.		Capacity	
	Basic	Acid	Basic	Acid	Basic	Acid	Basic	Acid	Basic	Acid	Basic	Acid
Central Western States	129	17	6,258	246	30	2	2,975	30	23	12	47	12
Eastern Pennsylvania and New Jersey	56	14	2,845	235	13	0	315	0	23	0	18	0
Cleveland-Canton District	37	6	1,920	120	42	2	2,790	45	114	33	145	38
Philadelphia District	86	29	4,380	825	38	0	1,973	0	44	0	45	0
Southern States	14	0	1,070	0	5	0	330	0	36	0	31	0
Southern Ohio and Kentucky	28	1	1,215	20	10	0	740	0	36	0	61	0
Northern Pennsylvania	10	13	500	345	0	4	0	210	0	31	0	61
Michigan and Western Ontario	7	9	250	115	1	1	40	10	14	11	16	9
Western New York and Canada	58	11	3,460	205	21	14	1,135	305	36	127	33	149
Mahoning and Shenango Valleys	92	13	5,900	355	37	2	2,795	45	40	15	47	13
Pittsburgh District	228	57	14,798	1,381	24	7	1,390	330	11	12	9	24
Western States	18	0	1,080	0	4	0	210	0	22	0	20	0
Totals	763	170	43,676	3,847	225	32	14,893	975	29	19	34	26

Company	Location	Built or Building			Proposed		
		Number	Capacity	Kind	Number	Capacity	Kind
Central Western States							
Minnesota Steel Co.	New Duluth, Minn.	10	75	B			
Inland Steel Co.	Indiana Harbor, Ind.	8	75	B	2	75	B
Grand Crossing Tack Co.	Grand Crossing, Ill.						
Illinois Steel Co.	Gary, Ind.	2	250	B			
Illinois Steel Co.	So. Chicago, Ill.	2	250	B			
Interstate Iron & Steel Co.	East. Chicago, Ind.				2	60	B
National Enameling & Stamping Co.	Granite City, Ill.	1	40	B			
Kokomo Steel & Wire Co.	Kokomo, Ind.	1	75	B			
United Depot Bridge & Terminal Railroad Co.	Kansas City, Mo.				3	75	B
Gas Traction Co.	Minneapolis, Minn.	1	5	A			
Keystone Steel & Wire Co.	Peoria, Ill.	2	75	B			
Work Mfg. Co.	Indiana Harbor, Ind.	4	90	B			
American Steel Foundry Co.	Indiana Harbor, Ind.	1	25	A			
Eastern Pennsylvania and New Jersey							
Bethlehem Steel Co.	So. Bethlehem, Pa.	6	50	B	8	100	B
Hewitt Steel Corp.	Newark, N. J.	2	30	B			
Hewitt Steel Corp.	Newark, N. J.	1	40	B			
C. Pardee	Perth Amboy, N.J.				1	50	B
Nagle Steel Works	Rahway, N. J.	1	25	A	Changed to B		
J. A. Roebling & Sons	Roebling, N. J.	1	40	B			
Carpenter Steel Co.	Reading, Pa.	2	25	B			
Cleveland-Canton District							
Massillon Rolling Mill Co.	Massillon, O.	7	50	B			
United Steel Co.	Canton, O.	5	75	B	8	50	B
Corrigan-McKinney & Co.	Cleveland, O.	12	75	B			
Otis Steel Co.	Cleveland, O.	6	50	B			
American Steel & Wire Co.	Cleveland, O.	1	75	B			
Canton Steel Foundry Co.	Canton, O.	1	30	A			
National Tube Co.	Lorain, O.	6	75	B			
Adamson Machine Co.	Akron, O.	1	15	A			
Cromwell Steel Co.	Lorain, O.	4	75	B			
American Steel Foundries.	Alliance, O.	1	40	B			
Philadelphia District							
Worth Brothers Co.	Coatesville, Pa.	8	50	B			
Alan Wood Iron & Steel Co.	Ivy Rock, Pa.	3	50	B			
Harrisburg Pipe & Pipe Bending Co.	Harrisburg, Pa.	2	50	B	1	40	B

(Concluded on page 45)

it is wisdom or unwisdom to increase his capacity, becomes to the American steelmaker the problem of deciding whether to maintain his plants at their present capacity on the assumption that they will square with a normal *post bellum* demand or to increase this capacity to meet the present demand and an assumed heavier-than-normal demand after the war.

In the bulk of such cases, the decision has been to increase the capacities of the plants. Many prominent steelmakers during the past 24 months of prosperity have solemnly and honestly voiced a warning against over-expansion and have pointed out that these new plants would prove a menace after the war that would engender ruinous competition. Then a few days, or perhaps weeks, later some of these executives would probably authorize an ambitious scheme of expansion in their own works. The answer to this paradox is found not in duplicity, but in dubiety; the steelmakers were not trying to perplex a competitor but were puzzled themselves.

The arguments of those observers who see trouble ahead for the American steel industry as a result of the extensive additions to our steelmaking capacity since the European war began, seem to be answered effectively by the actions of those whose future welfare is thus questioned. Almost without exception, the principal steel companies of the country have been building new open hearth furnaces in the past 29 months. When practically all of the leading steel company executives thus singly reach the same conclusion—to increase their steelmaking capacity—some solid foundation for their optimism must be concluded to exist.

In *The Iron Trade Review*, Jan. 6, 1916, an analysis was presented of the factors that were then most powerful in influencing favorable action on new construction plans. These factors, briefly, were: the bullish training of the older steel executives who had participated in the marvelous growth of the country's steel industry; practically every steelmaking unit was in operation, but the demand was unsatisfied; the probability of paying for new plants within a year of their construction, or of freeing old plants from what had been a stifling

Open Hearths Built Since War Started

(Concluded from page 44)

Company	Location	Built or Building: Number	Capacity	Kind	Proposed: Number	Capacity	Kind
Central Iron & Steel Co.	Harrisburg, Pa.	1	150	B	1	100	B
Diamond State Steel Co.	Wilmington, Del.	5	50	B			
Lukens Iron & Steel Co.	Coatesville, Pa.	4	50	B			
C. J. Hart	Philadelphia				4		
Phoenix Iron Co.	Phoenixville, Pa.	1	200	B			
American Iron & Steel Mfg. Co.	Lebanon, Pa.	4	50	B			
Penn Seaboard Steel Corp.	Chester, Pa.	3	25	B			
		1	8	B			
		1	5	B			
Virginia Steel Corp.	Hopewell, Va.				1		
Philadelphia Steel & Forge Co.	Tacony, Pa.	4	50	B	4	50	
Federal Steel Foundry Co.	Chester, Pa.				2	25	B
Washington Steel & Ordnance Co.	Washington, D. C.	1	35	B			
Southern States							
Atlantic Steel Co.	Atlanta, Ga.	1	50	B			
Gulf States Steel Co.	Alabama City, Ala.	2	50	B			
Chattanooga Steel Co.	Chattanooga, Tenn.	2	90	B			
Southern Ohio and Kentucky							
Ashland Iron Mining Co.	Ashland, Ky.	5	75	B			
American Rolling Mill Co.	Middletown, O.	4	75	B			
Whitaker Glessner Co.	Portsmouth, O.	1	65	B			
Northern Pennsylvania							
Standard Steel Works	Burnham, Pa.	2	75	A			
		1	50	A			
National Foundry Co.	Erie, Pa.	1	10	A			
Michigan and Western Ontario							
Algoma Steel Corp.	Saulte Ste. Marie, Ont.	1	40	B			
Superior Steel Casting Co.	Benton Harbor, Mich.	1	10	A			
Canadian Steel Corp., Ltd.	Ojibway, Ont.				12		B
Western New York and Canada							
Dominion Steel Foundry Co.	Hamilton, Ont.	6	20	A	1	40	B
Canadian Steel Foundries.	Montreal, Que.	2	25	A			
Canadian Steel Foundries.	Welland, Ont.	1	50	B			
Standard Steel Co.	Montreal, Que.	1	20	A			
Canada Cement Co.	Montreal, Que.	2	25	B			
Steel Co. of Canada	Hamilton, Ont.	1	50	B			
		3	60	B	1	60	B
Lackawanna Steel Co.	Buffalo	6	60	B			
Nova Scotia Steel & Coal Co.	Trenton, N. S.	1	50	B			
Wm. Kennedy & Son	Collingwood, Ont.	2	20	A			
Wickwire Steel Co.	Buffalo	3	50	B	1	50	B
Atlas Steel Casting Co.	Buffalo	2	25	A			
Donner Steel Co.	Buffalo	3	75	B			
Pratt & Letchworth Co.	Black Rock, N. Y.	1	25	A	1	25	A
General Car & Machinery Works	Montmagny, Que.	1	20	A			
Strong Steel Foundry Co.	Buffalo				1	20	A

Company	Location	Built or Building: Number	Capacity	Kind	Proposed: Number	Capacity	Kind
Mahoning and Shenango Valleys							
Youngstown Sheet & Tube Co.	Youngstown, O.	6	100	B			
Youngstown Iron & Steel Co.	Lowellville, O.	3	60	B			
Brier Hill Steel Co.	Youngstown, O.	4	85	B			
Republic Iron & Steel Co.	Youngstown, O.	4	75	B	2	75	B
Standard Seamless Tube Co.	Economy, Pa.	2	25	B			
Pittsburgh Crucible Steel Co.	Midland, Pa.	4	60	B	2	60	B
Pittsburgh Iron & Steel Foundries Co.	Midland, Pa.	1	25	A			
National Steel Castings Co.	New Cumberland, W. Va.	1	20	A			
Carnegie Steel Co.	Farrell, Pa.	3	75	B			
American Steel Foundries.	Sharon, Pa.	2	50	B			
Trumbull Steel Co.	Warren, O.	3	100	B			
Jones & Laughlin Steel Co.	Woodlawn, Pa.				1	250	B
Jones & Laughlin Steel Co.	Woodlawn, Pa.				3	75	B
Carnegie Steel Co.	Youngstown, O.	3	65				
La Belle Iron Works	Steubenville, O.	1	65				
Pittsburgh District							
Edgewater Steel Co.	Oakmont, Pa.	1	75	B			
		1	25	A			
West Leechburg Steel Co.	West Leechburg, Pa.	1	50	B			
Pittsburgh Steel Co.	Monessen, Pa.	4	80	B			
American Sheet & Tin Plate Co.	Vandergrift, Pa.	2	50	A	Changed to B		
Verona Steel Castings Co.	Verona, Pa.	1	35	B			
Forged Steel Wheel Co.	Butler, Pa.	4	60	B			
McConway Torley Co.	Pittsburgh	1	15	A			
Allegheny Steel Co.	Brackenridge, Pa.	1	100	B			
		1	50	B			
		1	75	B			
Carnegie Steel Co.	Homestead, Pa.				11	75	B
					3	125	B
Railway Steel Spring Co.	Latrobe, Pa.	1	50	A			
N. & C. Taylor Co.	Cumberland, Md.	1	50	B			
Carnegie Steel Co.	Clairton, Pa.	2	75	B			
Apollo Electric Steel Co.	Apollo, Pa.	1	35	B			
Mesta Machine Co.	W. Homestead, Pa.	3	40	A			
Sligo Iron & Steel Co.	Connellsville, Pa.				2	50	B
Braddock Foundry & Machine Co.	Braddock, Pa.				1	20	A
Jones & Laughlin Steel Co.	S. S. Pittsburgh				6	50	B
Cambria Steel Co.	Johnstown, Pa.	2	75	B	6	75	B
Firth Sterling Co.	McKeesport, Pa.	1	15	B	1	20	A
Fahenstock Mfg. Co.	Avonmore, Pa.	1	20	A			
Colonial Steel Co.	Monaca, Pa.	1	25	B			
Western States District							
Utah Iron & Steel Co.	Midvale, Utah	1	30	B			
Pacific Coast Steel Co.	So. San Francisco, Cal.	2	60	B			
Pacific Coast Steel Co.	Seattle, Wash.	1	60	B			
Columbia Steel Co.	Pittsburgh, Cal.				1		

burden of debt; the release of delayed orders from the railroads; the increasing tonnages demanded by the automobile industry; the expanding activities of the ship builders; the government's preparedness program; the wider uses of steel sheets; a healthy expansion of the domestic demand in all lines; greater opportunities in foreign countries.

In the light of our fuller knowledge, gained from our experiences during 12 months more of unprecedented conditions, it is interesting to check up the deductions of a year ago and determine their accuracy or inaccuracy with a view of determining what may be expected in the next few years.

The bullish training that led some steelmakers early in the war to spend money freely on new plants, confident of the country's ability to absorb the new supply, certainly has not been disproved during the past year. While production records of all kinds were being broken, prices were soaring to new levels and orders were constantly increasing. The bull of a year ago is still one today.

The Peak Load of 1916

While practically every steelmaking unit was in operation a year ago, it is safe to assert today that every unit capable of operating is turning out steel. The great increase in the number of open hearth furnaces during the past 29 months has proved entirely insufficient to satisfy the buyers' demands. The average weekly increase in capacity of 82,692 tons during 1916, was swallowed up without an effort and with 4,300,000 tons more capacity in operation at the close of 1916, prices were mounting and the demand increasing. Those steelmaking units not operating, suffer from lack of raw materials and not from an absence of opportunities to sell.

The possibilities of paying for new plants within six to 12 months of their completion are as great today, especially for plants controling their own supplies of iron ore and pig iron. Even with these raw materials higher, the spread still favors the steelmaker. The difficulties in securing deliveries, however, has determined many executives to purchase old properties and adapt them to the buying company's purposes, rather than to attempt the expansion of plants already owned. In some instances of this character, the purchase price of the new subsidiaries will be regained from a year's operation. In one instance such a purchase was made primarily to relieve the larger plant of a contract for furnishing raw material at a comparatively low figure. The difference between this contract price and what this steel will now bring in the open market will enable the purchasing company to pay for its latest subsidiary in less than a year.

In a domestic line, the dammed-up orders from the railroads have not been released, but the small streams of orders of a year ago have become a quiet river, although it has not attained the proportions of a flood. The check now is not what it has been, that is, the inability of the railroads to spend money which they had not earned, but rather the inability of the steel mills to accept the business now that it is offered. High prices are, of course, a strong deterrent, but with deliveries guaranteed, the railroad business would become immense.

The automobile industry has apparently little more than started its growth, and as a corollary, its demand for steel. During 1916, about 1,500,000 cars were built, increasing the country's total to 4,000,000. The ship building industry has grown to proportions unhoped for by even the most optimistic advocate of an American merchant marine. Here again demand is far in excess of supply. The government's preparedness program calls for the maximum tonnages of steel that had been suggested a year ago. In addition, orders are pouring in from all branches of an immense domestic consuming field.

Abroad, the opportunities are as plentiful as they were a year ago. The use of American steel has begun in newly developed fields of foreign trade; American banks and bankers, through direct branches or loans, are giving American capital free play in far distant lands, capital that will inevitably be the lodestone to draw thousands of tons of American steel products. The export field is new to most American steelmakers, the opportunities are not being offered on a platter but must be seized in competition with older hands at the export game, and after the war this competition will be infinitely more keen; but almost every gain made in 29 months is at present a clear gain, as we did little or nothing in the export trade before. The trade war after the war may cause the loss of much of this foreign trade, but some permanent gains have already been made.

Thus practically every factor contributing to a buoyant optimism a year ago is not only present, but more powerful now than then. An exception is found in the recent official revival of peace negotiations in Europe. But as far as this analysis deals with the motives which influenced steel company executives to increase their plants during 1916, such negotiations are immaterial. Insofar as the future is concerned, the possible approach of peace is of vital but still speculative concern. All we know is that peace would bring the steelmaker face to face with the situation he has studied and his deductions would soon be proved or disproved.

Construction Work Postponed

Ignoring the speculative discussions which the possibility of peace naturally encourages, we find some additional factors which the steelmaker must consider now as a result of the last 12-month experiences. Costs of construction have risen greatly during the year, and deliveries of building materials and mechanical equipment have become matters of months rather than of weeks. A new open hearth furnace today would cost easily 100 per cent more than one built 29 months ago. This fact, coupled with the impossibility of getting early delivery of supplies, has unquestionably postponed the construction of a number of new furnaces, and has also delayed the completion of many on which work has begun. This same fact will continue to restrict building operations.

High prices and the inability to secure steel have held back a great volume of business for purely domestic consumption. Much of this business must be released sooner or later. The railroads, for instance, have not been buying enough in recent years to keep their plants and equipment at full efficiency. With many of the carriers on a money-making basis again, the steelmaker expects larger purchases from that important source. The ship builders generally have contracts for one to five

years' work. Their demands are certain to be larger than in the *ante bellum* days. The building trade has not been as active as most other lines. In sheets, the big roofing trade in the south has consumed much smaller tonnages than its normal requirements. The automobile industry has not attained its full capacity for steel consumption.

In foreign trade, the future is still largely speculative. The economic plans of the two hostile groups, the enforced co-operation between government and business in Europe, the apparent certainty of keener competition after the war, all of these factors introduce disquieting fears of our ability to become a big exporting nation. But as offsets we have the strong probability of governmental sanction of combinations of business men for foreign trade, the progress we have already made, the growing experience of our steelmakers and bankers with foreign trade, the probable expansion of our merchant marine, and the belief that the foreign demand for steel in peaceful forms will equal and perhaps excel the present call from the belligerents.

Corroborative evidence thus exists to justify our free-handed policy of building more steelmaking furnaces. The country now has the greatest steel capacity in its history. The steel plants are better off mechanically and financially. Quantity production has given many companies valuable lessons in economy. During the last 29 months emphasis has been placed principally on steel producing units. The future is certain to see more attention paid to the construction of finishing mills. This will mean that new uses will be found for steel which will cause an increase in consumption.

With newly built furnaces in their plants, steelmakers have some doubts concerning the future, but they still carry these furnaces as assets and not as liabilities.

During 1916, the country's open-hearth steelmaking capacity was increased by 4,300,000 tons, this figure being the rated annual output of the 105 furnaces which were built. The extent of this increase is better realized when it is recalled that only 43 furnaces of 1,759,000 tons capacity were built in 1915; nine of 747,000 tons capacity in 1914; and 62 of 3,120,000 tons capacity in 1913. New capacity added last year thus represents an increase of 245 per cent over the increase in 1915; 576 per cent over the increase in 1914, and 138 per cent over the increase in 1913.

The number of open-hearth furnaces under construction at the opening of this year is 95, with a rated annual capacity of 4,795,500 tons. This is an increase of 1,040,500 tons over Jan. 1, 1916, as on that date 74 furnaces of 3,755,000 tons capacity were being built. At the opening of 1915, 43 furnaces of 1,760,000 tons capacity were under construction, and on Jan. 1, 1914, 40 furnaces of 1,830,000 tons capacity were being built. The prospective increase in open-hearth capacity during 1917 is thus considerably heavier than in any of the past three years.

The Iron Trade Review at the beginning of 1915 estimated the country's steelmaking capacity at 37,500,000 tons. Allowing for increases during 1915, the capacity on Jan. 1, 1916, was set at 39,000,000 tons. In the same manner, the increase during the past year has brought the country's capacity on Jan. 1, 1917, up to a little more than 43,000,000 tons. If all of the furnaces now under construction are completed during 1917, the country's capacity at the opening of 1918 will be 48,000,000 tons, which will represent an increase of about 11,000,000 tons, or nearly 30 per cent, in three years.

The table on pages 44 and 45 presents in detail the additions to the steelmaking capacity of the United States and Canada since the European war started. A significant fact, first revealed in this tabulation, is the statement that an average of nine open-hearth furnaces have been built in this country every week since hostilities began abroad. The largest increase has been made in the central western states, where 32 basic and acid furnaces of a rated capacity of 3,005 tons have either been built or construction work started. The district embraced in the Mahoning and Shenango valleys is a close second, the new steelmaking additions there including 39 basic and acid furnaces of a rated capacity of 2,840 tons. Practically an equal increase has been made in the Cleveland-Canton district, where 44 basic and acid furnaces of a rated capacity of 2,835 tons have been built. The increase in basic capacity since the war started has been 34 per cent, and in acid capacity 26 per cent.

In contrast with the large increase in steelmaking capacity, only three new blast furnaces were blown in during 1916. These furnaces have a combined annual capacity of 530,000 tons. The increase in pig iron capacity in 1916 exactly equals that in 1915, as shown in the following table, which shows the capacities of furnaces blown in from 1905 to 1916:

YEAR	GROSS TONS
1916	530,000
1915	530,000
1914	None
1913	550,000
1912	1,000,000
1911	565,000
1910	1,794,000
1909	1,930,000
1908	1,188,000
1907	2,065,000
1906	1,135,000
1905	1,292,000

The country's pig iron production in 1916 easily exceeded 39,000,000 tons. Adding to this the new 1916 additions gives about 40,000,000 tons, which can be conservatively estimated as approximating the country's maximum capacity under present conditions.

The new furnaces completed in 1916 were one each by the Cambria Steel Co.; Corrigan, McKinney & Co., and the United Furnace Co. Twenty-one furnaces were being built on Jan. 1, 1917. These were: Two by the Cambria Steel Co.; one by Corrigan, McKinney & Co.; one by the Donner Steel Co.; eight by the Bethlehem Steel Corporation; one by the Republic Iron & Steel Co.; one by the Sloss-Sheffield Steel & Iron Co.; one by the Whitaker-Glessner Co.; one by the Inland Steel Co.; four by the Indiana Steel Co., and one by the Midvale Steel & Ordance Co. The prospective increase in pig iron capacity this year is the largest in years and follows a wider appreciation of the fact that the gap between steelmaking and pig iron producing capacity was becoming perilously wide.

In addition to the furnaces on which work has begun, 11 more have been authorized. These include two by the Ford Motor Co.; four by the National Tube Co.; one by the Youngstown Sheet & Tube Co., and five by the Bethlehem Steel Corporation. In addition, the following companies expect to build shortly: Detroit Iron & Steel Co., one furnace; Iroquois Iron Co., one and probably two furnaces; Mark Mfg. Co., one furnace; the United Furnace Co., one furnace

Pig Iron Output Falls Last Month

Shortage of Coke and Cars Restricts Production in December—1916 Output Exceeds 39,000,000 Tons, Setting a New Record—Many Furnaces Banked as New Year Opens

THE production of pig iron in December showed a marked decline from November, the decrease being the result of the shortage of coke and cars. A number of furnaces were banked in the second half of December, this condition being particularly true in Pennsylvania and Ohio. The total production of coke and anthracite pig iron in December was 3,208,382 tons, compared with 3,317,805 tons in November, a loss of 109,423 tons.

Last year, of course, easily set a new mark in pig iron production. The completed figure, just compiled, indicates an output last year of 39,043,327 tons. This figure represents an increase of over 10,000,000 tons over 1915, and of 8,350,000 tons over 1913, the previous record-holding year. When the production of the charcoal furnaces in 1916 is added, a total output for the year of nearly 39,500,000 tons is indicated. As shown in one of the accompanying tables, the production of coke and anthracite pig iron in the second half of 1916 was practically the same as that in the first six months of the year. This was the first half-year period since the upturn began which failed to show a large increase over the preceding six months.

A greater decline was shown in the output of merchant iron than in non-merchant iron. The merchant furnaces of the country produced 808,588 tons in December, against 870,757 tons in November, a loss of 62,169 tons. The steel works or non-merchant furnaces produced 2,355,792 tons in December, against 2,397,635 tons in November, a loss of 41,843 tons.

The daily output of pig iron in December was 103,496 tons, against 110,593 tons in November, a loss of 7,097 tons. The steel works furnaces averaged daily during December 75,993 tons, against 79,921 tons in November, a loss of 3,928 tons. The merchant furnaces averaged daily last month 26,083 tons, against 29,025 tons in November, a loss of 2,942 tons.

The number of active stacks on Dec. 31 was 311, compared with 322 on Nov. 30, a net loss of 11. Many furnaces were banked as the year closed, but a number which had been banked during the second half of December were again put in blast in the closing week of the month.

The output of spiegel last month shows a loss of 4,102 tons, the December production being 18,551 tons, compared with 22,653 tons in November. The ferro production in December was 25,451 tons, compared with 26,760 tons in November, a loss of 1,309 tons.

AVERAGE DAILY PRODUCTION.

	1916.	1915.	1914.	1913.	1912.
Jan.	102,319	51,323	60,624	89,929	66,220
Feb.	106,157	59,521	67,450	92,095	72,372
Mar.	107,343	66,009	75,534	89,123	77,791
Apr.	107,517	70,484	75,383	91,812	79,254
May	108,535	72,747	67,646	90,865	80,753
June	107,127	78,998	63,486	87,229	81,125
July	103,907	82,687	63,075	82,525	77,502
Aug.	103,156	89,510	64,403	81,839	80,650
Sept.	106,935	94,478	62,757	83,137	81,482
Oct.	113,167	100,656	57,007	81,933	86,569
Nov.	110,593	101,174	50,042	74,322	87,985
Dec.	103,496	103,278	48,236	63,746	89,590
Av'r'ge	106,676	81,022	62,934	83,980	80,124

MONTHLY PRODUCTION.

	1916.	1915.	1914.
January	3,171,878	1,591,024	1,879,336
February	3,078,548	1,666,592	1,888,607
March	3,327,630	2,046,280	2,341,551
April	3,225,496	2,114,518	2,261,501
May	3,364,584	2,255,157	2,097,019
June	3,213,818	2,369,932	1,904,566
Total 1st half.	19,381,954	12,043,503	12,372,580
July	3,221,127	2,563,311	1,955,324
August	3,197,838	2,774,825	1,996,483
September	3,208,041	2,834,342	1,882,718
October	3,508,180	3,120,340	1,767,227
November	3,317,805	3,035,235	1,501,269
December	3,208,382	3,201,605	1,495,325
Total 2d half.	19,661,373	17,529,658	10,598,346
Grand total.	39,043,327	29,573,161	22,970,926

DECEMBER PIG IRON

States.	No. of stacks.	No. in blast last day of month. Dec.	Nov.	Total tonnage made. Merchant.	Non-Merchant.	Totals— Dec.	Nov.
Pennsylvania	154	119	129	246,508	1,040,817	1,287,325	1,348,533
Ohio	77	63	67	153,576	537,237	690,813	731,531
Alabama	45	30	29	138,216	100,144	238,360	233,879
Virginia	22	9	8	30,501	.....	30,501	29,165
New York	26	19	17	56,558	103,494	160,052	184,125
New Jersey	6	1	1	6,610	.....	6,610	6,384
Illinois	24	24	24	53,677	288,165	341,842	333,331
Colorado	6	3	3				
Indiana	10	10	10				
Maryland	4	4	4	33,148	228,699	261,847	253,669
Wisconsin	6	4	5				
Kentucky	7	4	4				
West Virginia	4	3	4				
Tennessee	17	11	10	53,840	29,800	83,640	85,469
Washington	1	0	0				
Georgia	2	0	0				
Texas	3	0	0				
Minnesota	3	3	3	35,954	27,436	63,390	62,306
Michigan	3	3	3				
Missouri	1	1	1				
Spiegel—All states						18,551	22,653
Ferro—All states						25,451	26,760
Totals	421	311	322	808,588	2,355,792	3,208,382	3,317,805

Spectacular

Year in the History of Pig Iron in Birmingham District.

Birmingham, Ala., Jan. 2.—The year just closed has been the most spectacular one which the Birmingham district has ever witnessed in the matter of its mineral development. The year 1916 opened with $14.75 price for Birmingham iron and has closed at $24 per ton for shipment through the entire year of 1917. The several furnace interests are heavily sold up at this figure for next year deliveries. The year opened with furnace coke selling at $2.65 to $2.75 per ton at the furnace and foundry coke $3 to $3.25 per ton at the ovens, and has closed with large contracts having been made far into the year 1917 at $4.50 and $5.50 per ton, respectively, and "spot" coke selling for $9 to $10 per ton. Production of pig iron has prodeeded during the latter part of the year on the highest basis known to the district. The production of basic iron in the district at the present time is unprecedented, and instead of the price being on a par with Birmingham No. 2 foundry iron, it has kept practically a dollar a ton ahead. From four to six foundry stacks have been kept busy on the production of basic iron, and the Tennessee company, which usually keeps four or five stacks on foundry iron, has practically withdrawn from the foundry iron market by reason of its urgent need of basic iron for steel products. During the year, there was put in blast six or seven blast furnaces that have been idle since the depression of 1907.

Steel Doffs Rags for Royal Robes

War's Magic Works Modern Miracle in America's Greatest Industry —The Transformation is Here Described and Brief Glimpse at Future Taken

BY GUY F. CREVELING

ON A DREARY December day, two years ago, the president of the Joyce Steel Co. sat, dejected, in his modest hillside office. His eyes wandered from the litter of unopened mail upon his desk to the steel plant in the valley below, stretching its dark bosom along the winding river. It was not a novel spectacle to David Carson. The Joyce Steel Co was the product of his genius and energy. He had molded the insignificant shop of years ago into an industrial enterprise which was the mainstay of the community. His gaze was almost a caress for the child of his handiwork, but now it was filled with sadness.

No steam was puffing from the exhausts, no smoke curling from the high smoke stacks. The rumble of the rolling mill, the whirring of belts and the bumping of freight cars, all were silenced. The workmen who not so long before had thronged the plant and yards, watching the levers, tending the furnaces, running the cranes, hauling the trucks and at various other tasks, were gone. Only a watchman went his rounds. Cobwebs were springing up almost over night. On the door of the little employment office at the gate, was written, in five languages, the laconic phrase, "No Help Wanted."

President Carson turned wearily to his papers. He did not realize it, but worry was aging him faster than all his strenuous years of activity. He knew about what to expect in the mail. Here was a letter from one of the large stockholders, complaining of the company's inability to pay dividends and suggesting that if the business were not soon restored to a satisfactory basis, a change in management might be forthcoming. Another letter bore the official letterhead of the mayor of the city. This proved to be an urgent plea that the company take steps immediately toward resuming operations. The townspeople were beginning to feel the shutdown keenly. Many mechanics and laborers were leaving to seek employment elsewhere; those who remained had strained their credit with the merchants and were face to face with actual want—so the letter read. Carson smiled sadly as he thought of the strenuous but fruitless efforts of his salesmen out in the field.

There were other letters. One was a reminder from the bank of bond interest due in January—this was December. Another was a stern request from a blast furnace company that a note, given months before for pig iron, be paid. It pointed out that money was tight, that long term credits were unusual in the trade and that only Carson's personal standing had secured the concessions already made. Other messages were of similar nature. Mingled with them were a few petitions for charities, including foreign missions and a plea for Belgian refugees.

Record Earnings in 1918?

"Nineteen hundred and sixteen probably will go down in history as one of the most remarkable years that the iron and steel industry has ever known. Without the necessity of resorting to prophecy, we can assume that the year 1917 will see the blast furnaces and steel works of this country operating at capacity."

James A. Farrell, president of the United States Steel Corporation, made this remark last September.

Translating production into earnings, one may, almost with certainty, predict record breaking profits for 1917. Further, if business continues six months longer as it is at present, still higher earnings will come into sight for 1918, as a sequel to the rapid advances in the steel market.

Little wonder that David Carson was discouraged! Again his eyes strayed to the long dark roofs below. Almost subconsciously he appraised the buildings, real estate and equipment and inventoried the huge piles of pig iron and scrap which lay slowly rusting. Assets greatly exceeded liabilities, he mused, but cash, liquid assets, working capital had dwindled to the danger mark. Perhaps he had been too hasty in pushing that additional open hearth construction early in 1913. It had been a strain on the company's resources. Yet who would have dreamed that business would dwindle so miserably?

Some people blamed the downward revision of the tariff the year previous for the widespread industrial depression. Others asserted the condition was a psychological phenomenon. Still others believed it was merely a reaction due in the natural order of things. Then, in July, 1914, the European war cast its shadow over the earth. Panic swayed the financial markets of the world. Dark doubts, arising from the grave of international peace, shadowed the business outlook of the United States. People conserved their resources. Industry and commerce lapsed into coma for a time. The steel trade was the dullest of the dull. The public must eat, wear clothes and do the thousand and one things which help to swell the bank clearings, whether times are good or bad. But loss of confidence means a cessation of activity in the bigger things. It means a suppression of the desire to progress along any of the lines of expansion which require large quantities of iron and steel. When fear swept the country the last few months of 1914, work was dropped on many buildings which were already half erected, and not resumed until months later.

This was the state of affairs which confronted President David Carson. The Joyce Steel Co. was no isolated case. Scores of companies were facing bankruptcy. November and December of 1914 will long be remembered as the worst two months in the history of the steel industry. Millions of workmen were idle over the country and thousands of families in want. The future seemed to hold scant hope for improvement. The leaders of some of the biggest corporations, men whose opinions always receive respect, shook their heads gravely as they tried to look forward. Good times were not to be expected while the war raged, they said. But Carson was a typical steel man, a fighter. The Joyce Steel Co. was suspended over the brink of the chasm, yet it held on.

* * *

President Carson is busy with his mail another December day, two years later. A vast change has taken place

in the affairs of the Joyce Steel Co., a transformation which has extended even to the appearance of its president. He appears younger and more sprightly. The furrows of care seem less deep.

The plant itself has changed. New buildings are visible from the office windows, housing recently completed open hearth furnaces, additional mills and other equipment. The scene is one of extreme activity. The plant's capacity is being pushed day and night to the last possible ounce of steel. The sign posted on the little employment office now reads, "Men Wanted," and the company has agents scouring the surrounding country for labor. The unpretentious brick office itself is all abustle with activity as the members of the Joyce organization strive to handle the unprecedented rush of business. Over in the traffic department, the car situation is being studied assiduously, for inability to secure sufficient cars to ship the company's products is one of the few flies in the ointment. The purchasing agent is having his troubles, too, for raw materials and machinery are difficult to buy and deliveries are delayed. Up in the sales department, the sales manager is trying to convince a frantic customer that the Joyce Steel Co. is sold up for a year ahead. Inquiries come in by mail and telegraph from anxious consumers who waited too long before they protected themselves on their contracts. The salesmen of the Joyce Steel Co. spend much of their time looking after the interests of their customers, sometimes trying to pacify them, in fact doing almost anything except selling steel.

Enjoying Good Times at Last

The president of the Joyce Steel Co. may well feel complacent. On Jan. 1, 1917, the company redeemed from earnings its entire funded indebtedness, although some of the issues do not mature until 1920. Yet, only two years ago, bond interest almost proved the company's undoing. Joyce Steel common stock has risen from less than 50, two years ago, to above 200. An issue of stock was prorated among stockholders a year ago, to provide funds for improvements. The new stock was subscribed for eagerly and the man who took the biggest block was the same individual who had grumbled about dividends not so long before. No one knows just what the company is earning, but its profits are rumored to be equal to more than 70 per cent on the common stock while dividends on that issue amount to 8 per cent. The Joyce Steel Co. has survived the lean years and now is enjoying its fat ones. The strength it is storing up will sustain it for many years to come.

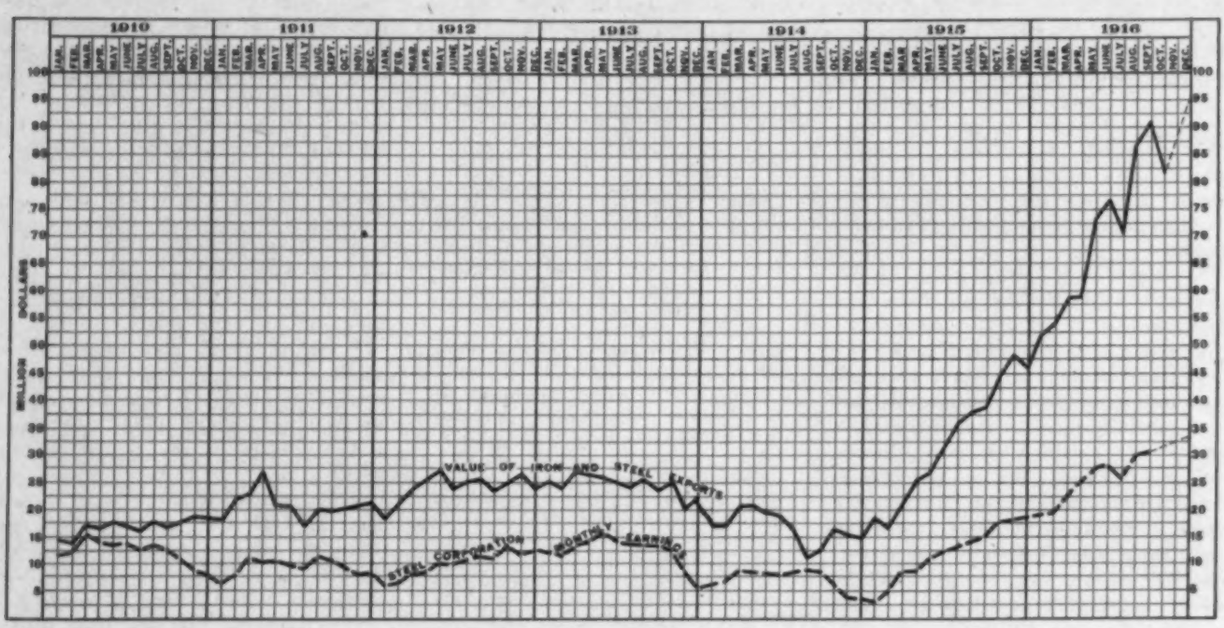
* * *

The story of the Joyce Steel Co. is, in a general way, the history of many American iron and steel companies. Steel, the commodity, is conspicuous today by its scarcity. Two years ago, it was a drug on the market. The steel trade accordingly has risen from extreme depression to a degree of prosperity exceeding its wildest dreams.

We are living in the golden age of iron and steel. The grandchildren of the steelmakers of today will look back in awe upon the financial achievements of their forefathers. The years 1916 and 1917 will be marked in brilliant letters in steel trade annals. The percentage of profit to capital invested is higher than it ever was before. Probably it is higher than it ever will be again.

Whence comes this prosperity? Every man in the steel trade will answer that the impelling force is war—stupendous, spectacular, expensive, horrible war. The mighty conflict is a struggle of iron and steel. Each military organization is as much a machine as the steel plant down in the valley and a thousand times more complex. The one uses men to fashion steel; the other steel to destroy men. Iron, in the form of machinery, guns and shells, is the fundamental of modern warfare. Germany possesses an advantage over her enemies in her natural iron and steel resources, but England, mistress of the seas and banker of the world, has tapped the great American reservoir.

The result is an old story. American steel capacity has not been equal to the demands upon it. Because of the war, the United States has received billions of new wealth, stimulating the American public to push new enterprises or to expand old ones. The domestic consumer wants



STEEL EARNINGS JUMP AS STEEL EXPORTS GROW

This chart is a graphic picture of the remarkable rapidity with which earnings have risen since the world began to knock on our doors for iron and steel. The earnings of the United States Steel Corporation—a representative steel producer—are here contrasted with the values of iron and steel exports by months. Note the parallel increases during the past two years.

steel and is willing to pay for it almost any price asked. But Europe, in a death grapple, must have steel and needs more than the surplus of American production over domestic consumption. Thus, the steel market comes to resemble an auction sale.

Naturally, the established producers of iron and steel derive the greatest benefit from this situation. It is only human that they should be anxious to book as much of the most profitable business as possible, but they have not forgotten to take care of their regular customers.

As 1917 begins, no one knows definitely just what the steel trade accomplished financially in the calendar year 1916. Even the auditing departments of the various companies are unable to say how their accounts stand. A month or more will pass before the regular annual reports to stockholders are ready for publication. The steel trade's dividend record, the new construction it has authorized and its redemption of notes and bonds, are actions which proclaim more loudly than statistics the success of the past year's operations. However, sufficient official figures are available to give the public at least an inkling of what has been done financially.

One knows, for instance, that the United States Steel Corporation earned $227,656,739 in the first nine months of last year. With this as a basis, an estimate of $320,000,000 for the entire year will not far miss its mark. Such earnings, after normal deductions for interest and other charges, including preferred dividends, would leave a surplus available for dividends on the common stock equivalent to at least 46 per cent on that issue. The significance of this figure will be appreciated when it is contrasted with the average of 8 per cent earned on common in the years 1901 to 1915, inclusive. The best year prior to 1916 was 1907, when the surplus for common was 15.64 per cent. In 1915 the surplus was a little less than 10 per cent, while in 1914 a deficit of $17,000,000 was shown.

What Independents Have Done

By the same method of reasoning, the earnings of some of the important independent steel companies may be estimated. As official figures are not available, the only alternative is to tell what is expected of the various companies.

The Lackawanna Steel Co. probably earned about $34 a share on its $34,750,000 capital stock in 1916, judging from the results of the first three-quarters of the year. This company's annual earnings in the 10 years previous to 1916 averaged $4.72 a share.

The Carbon Steel Co., Pittsburgh, reported net earnings equal to 80 per cent on its $3,000,000 common stock in the fiscal year ended Oct. 1, after allowances for expenses, interest and preferred dividends.

The Crucible Steel Co. of America, Pittsburgh, reported earnings of 52 per cent on its $25,000,000 common stock in the fiscal year ended Sept. 1.

The Pittsburgh Steel Co., whose fiscal year ends June 30, is said to have earned over $100 a share for its common stock in the calendar year 1916.

The Inland Steel Co., Chicago, last autumn was said to be earning at the rate of $140 a share on its $10,000,000 stock.

The Central Steel Co., Massillon, O., is a new company which appears to be performing financial miracles. This company recently was reported to be earning at the rate of $166 on its $1,346,000 common stock, or 25 times its preferred dividend requirements.

The Gulf States Steel Co. in the first 10 months of 1916 earned $1,945,193, compared with $609,943 in 1915. In the 23 months following this company's reorganization, beginning Feb. 1, 1913, to Jan. 1, 1915, its earnings were $279,005.

The Sloss-Sheffield Steel & Iron Co., Birmingham, Ala., earned over 15 per cent on its $10,000,000 common stock in the fiscal year ended Nov. 30, 1916, compared with 0.53 per cent earned on the same issue in 1915 and 0.21 per cent in 1914.

The financial prowess of the little Atlantic Steel Co., Atlanta, Ga., is noteworthy. This company's earnings last September were at the rate of $96.24 per share on its $1,000,000 common stock. For the entire year, it probably will show over $80 a share.

The figures for four of the leading independent steel companies are not available. The Bethlehem Steel Corporation and the Midvale Steel & Ordnance Co. each absorbed a large independent steel company during the year. The former took over the Pennsylvania Steel Co. and the latter the Cambria Steel Co. Since these changes, neither company has made public its earnings and estimates cannot be attempted to any degree of accuracy. The Jones & Laughlin Steel Co. and the Youngstown Sheet & Tube Co. have never divulged their earnings.

Guesses might be hazarded as to the earnings of many other important steel companies, including the Brier Hill Steel Co., Youngstown; the Youngstown Iron & Steel Co., Youngstown; La Belle Iron Works, Steubenville, O.; the American Iron & Steel Mfg. Co., Lebanon, Pa.; the Whitaker-Glessner Co., Wheeling; the United Alloy Steel Corporation, Canton, O., and enough others to fill a charging box, more or less. But sufficient instances have been related to demon-

The Decline in Prices Will Be Gradual

EUROPE will not be able to turn its industrial organizations from the sword to the plowshare in a day. The signing of the treaty of peace will not automatically stop placing of foreign orders in this country. It is more likely they will taper down gradually over many months and that the government's monthly export figures will reflect this scaling down for more than two years after the close of the war. During this time, the shock of the changed conditions will have passed and the task of readjustment in this country will have been accepted in a matter of fact way.

Other factors may contribute toward strengthening the steel market and making the decline less abrupt. For example, leading ship builders say their industry will be busy for five years after the war to replace merchant vessels lost since Aug. 1, 1914. The mill capacity to roll ship steel is limited and this will keep prices for this class of steel relatively high; such strength is always contagious. The government's big preparedness program is another outlet for steel. Then there are other steel products whose high prices have limited consumption and for some of these products demand is being pent up, to be released when the decline in steel prices halts at definitely lower levels.

The steel trade is clad in armor of gold, fashioned from enormous war profits. This armor will be of great protection in the first shock of peace abroad and in the prolonged readjustment to follow. But to cope successfully with all comers in the field of international commerce, all American industry must be given the sword of government co-operation. The railroad policy toward business must be revised.

strate that the steel trade is earning profits it never before dreamed of.

Now that the industry is literally rolling in wealth, for the first time in its history, the question arises: What disposition of earnings is being made by the various companies?

A large part of the current earnings is going into wage increases, for all steel companies have advanced the wages of their men from 30 to 40 per cent in the past year. Some of the companies have not distributed 1 cent more to their stockholders from war time profits than the regular payments customary before the war. On the whole, steel mill employes have fared far better from the war time prosperity than the steel mill owners.

The first half of 1916 was marked by the gradual resumption of dividends suspended during the 1914 depression and by initial payments by some companies. The second half of the year saw certain companies declare conservative extra dividends, while many concerns took advantage of their new-found prosperity to square accounts with holders of their preferred shares on which unpaid dividends had accumulated.

In January, 1916, the Steel Corporation resumed dividends on its common stock, discontinued just a year previous. The rate established was 5 per cent per annum, but 2 per cent extra was paid during the year. The Bethlehem Steel Co. declared an initial dividend of $30 a share on common in January, last year, payable in quarterly installments over the year. The Republic Iron & Steel Co. paid up 11 per cent accumulated dividends in addition to the regular dividends of 7 per cent due on the $25,000,000 preferred stock, clearing the way to an initial payment on the common when the directors may deem such action advisable. The Lackawanna Steel Co. put its stock on a 6 per cent basis during the year, and declared an extra of 3 per cent; previous to 1916 only 1 per cent had been paid on this issue. The Brier Hill Steel Co. also put its common stock on a 6 per cent basis, for the first time. The Pittsburgh Steel Co. paid 7 per cent accumulated dividends on its $10,500,000 preferred stock, during the year, in addition to regular dividends. The Carbon Steel Co. resumed dividends on its second preferred stock and put its common stock on a dividend basis of 6 per cent a year, for the first time in 10 years. The American Iron & Steel Mfg. Co. resumed dividends on its common stock at the rate of 5 per cent per annum, after a suspension of these payments in April, 1915. The Colorado Fuel & Iron Co., during 1916, cleaned up accrued dividends of 62 per cent on its $2,000,000 preferred stock. The Eastern Steel Co. wiped out 63 per cent in accumulated payments on its $2,000,000 first preferred stock.

The foregoing examples by no means complete the list of dividend increases and initial payments among iron and steel companies last year, but they suffice to show that stockholders are beginning to share in the war time profits.

However, dividend distributions fall far short of measuring up to the earnings. The Steel Corporation, for instance, may have earned $46 a share on its common stock last year, but it distributed only $7 a share to holders of that stock. The Corporation and other steel producers have used the larger part of their earnings to strengthen themselves, financially and mechanically. They have made big allowances for depreciation, new construction and other reserves. Plants have been brought to the highest degree of operating efficiency.

Many companies have used part of their profits to cut down their interest charges. The Lackawanna Steel Co. has retired $10,000,000 5 per cent bonds in the past two years. The Brier Hill Steel Co. on Feb. 1, 1917, will retire all of its outstanding bonds, amounting to more than $2,000,000; these bonds were issued to mature serially from 1917 to 1926. The Youngstown Sheet & Tube Co. on Jan. 1 called in all its outstanding bonds, to the amount of more than $1,790,000. The Pittsburgh Steel Co. last year redeemed all of its $5,000,000 6 per cent gold notes, dated Jan. 1, 1915, and issued to mature as follows: $1,500,000 on Jan. 1, 1918; $1,500,000 on Jan. 1, 1919, and $2,000,000 on Jan. 1, 1920. The United States Steel Corporation purchased $25,000,000 of its bonds long held in Great Britain by the Carnegie Fund. These are only a few instances, but they show the trend of the times.

The "trend of the times" is best expressed in the single word "preparedness". Steel companies have been cleaning house in preparation for after war exigencies, because they realize that a readjustment is inevitable. When, how gradual or how prolonged this readjustment will be, no one may say, for to none is given the power of seeing into the future. But, financially, the steel trade is in readiness.

What will take place after the war? The world's keenest business intellect, savants, economists, captains of industry and masters of finance are trying to answer this question—and so is the ordinary man in the street. Exhaustive studies have been made of commercial treaties, home and foreign trade conditions, international and domestic politics, immigration, finance, living standards and a multitude of other factors involved in this momentous problem. The net result, so far from enlightening the student, only entangles him the more in the maze of uncertainty.

Theorists have some facts with which to work, but they have evolved a variety of conflicting opinions. Some predict the United States will be drawn into a vortex of an after war trade war. At the other extreme, are prophets who just as sincerely believe top-notch prosperity will prevail in the American steel trade the next five to ten years. After all, one man's guess is as good as another's.

At present steel prices are higher than ever before; to find a parallel one must go back to the days of the Civil war boom in wrought iron products. The fundamental reason for this condition of the steel market lies in the law of supply and demand. As 1917 begins there is a world shortage of iron and steel, due partly to an abnormal demand for military purposes and partly to a diminished world supply resulting from the withdrawal of men from productive fields.

Europe now is our best customer, because of the inexorable needs of war. After the war, Europe will be inspired by entirely different motives from those which now are impelling hostile hosts at each other's throats.

Steel Stocks Discount Prosperity

The rise in the steel stocks, discounting present conditions in the steel trade, has been one of the phenomena of the past two years. United States Steel common is a representative steel stock. Its movement has been paralleled in varying degrees by the shares of all other steel producers. At the outbreak of the war Steel common declined from about 60 to a fraction over 50. In January, 1915, the Corporation suspended dividends on this issue, which brought a near panic on the stock exchange and forced the quotation down to 38. From that time forward, however, the stock gradually advanced, with occasional declines, until, on Oct. 22, 1916, common passed 121, at which price the preferred was selling. Then, for the first time, the common was rated as more valuable than the preferred issue. A short time later the common stock sold as high as 129¾. At this price the stock market valuation of Steel common's 5,083,025 shares outstanding was $661,522,494, which compares with a valuation of $193,154,950 for the same stock when it was selling at 38 in January, 1915.

The warring nations are lavishly spending the accumulated wealth of centuries for munitions and a large part of this wealth is being spent in the United States. When the war is over, America will be fat from war profits; Europe will be thin from war's bleeding. It is natural to expect that Europe's ambition will be to regain its gold, to re-establish its financial and industrial prestige. America's problem will be to assist Europe in its rehabilitation, but not at the expense of American finance and business. When the war is ended, Europe will cease to be America's best customer; the reconstruction of devastated districts and other peace work can be spread over a long period of years. But there is little danger that either of the two main factions will unite its component nations into economic alliances excluding the United States. This country will be the best market to sell in and England and Germany will make every effort to build up their trade here.

Whether they will be able to do so or not depends partly upon costs and tariffs. Labor is the biggest item in costs and labor now is commanding record wages, both in this country and abroad. In Europe, the high price of labor is due mainly to the great number of men withdrawn to the front. In the United States the high wage scales are due to the insufficient supply of labor to handle the vast amount of business heaped upon this country by the war. After the war, 20,000,000 men will return to Europe's plants and fields. There they will find millions of women who have taken up their tasks in their absence. The obvious conclusion is that labor at first will be over abundant and that wages must decline. Balancing this condition, to some extent, is the probability that higher taxes resulting from enormous war debts will so increase the living cost that a scale of wages relatively higher than that which existed before the war will be necessitated. At the same time, European living standards have been lowered by war economies, while America's labor has waxed fat on war profits. But when Europe is relieved from war's grasp, much business now thrown to the United States will be automatically curtailed. The supply of labor in this country then will be no longer insufficient and wages will undergo adjustment to competitive conditions. This is not a pleasant prospect, but it is inevitable.

Another factor in after war business is industrial organization. The war has welded the industrial systems of the various warring nations into solid units to combat a common enemy. Government regulation of industry and control of prices have reached a point unparalleled in history. This is possible in war time, but it is a question whether foreign manufacturers and merchants will be willing to submit to continued autocratic supervision of their affairs after the return of peace. Nevertheless it is true that the steel trades of both England and Germany will receive greater co-operation from their respective governments than ever before. In this country, governmental co-operation has gone little beyond the talking point.

After the war, the United States steel trade will not be competing with the German steel trade in the German market, with the French steel trade in the French market nor with the English steel trade in the English market. It will be competing with these countries in the United States market, the South American market, the Russian market and various foreign markets. Combinations of foreign buyers and sellers will work for the domination of these markets. Therefore it is essential that American manufacturers and merchants be given legal authority to combine in export trade. The government of the United States should also negotiate commercial treaties while Europe is busy with the international arrangements by which it hopes to recoup war losses.

But the legislation needed most of all is the establishment of a flexible, "bargaining" tariff, expertly devised, which will insure stability to domestic business while at the same time it will permit this nation to enter the contest for foreign markets.

The first definite news of peace will be a profound shock to the industrial structure of the United States, founded as it is upon war business. The steel market will decline, principally because every one thinks it will. Buyers sigh as they pay present prices, but console themselves with the thought that after the war is over prices will come down. It is not unlikely that the first definite news of impending peace will mark the crest of the advance in steel prices.

Buying naturally falls off in a declining market, and this tends to quicken the decline. But when the turn comes, steel producers will be sold practically to capacity for about a year ahead. Mill specifications will be held against a large part of this business and companies will not be forced to grant radical concessions to keep their mills busy, for many months after the turn. This condition will buoy up steel earnings for a year, although it remains to be seen how well sellers will be able to hold their customers to high priced contracts in a declining market. The foreign contracts are firm sales, in some cases the buyers having the option of specifying for peace products instead of shell steel, if they desire.

It now seems inevitable that steel company earnings in 1917 will surpass those of 1916, even if the war should end this month. Some business has been done for delivery in 1918 at the current prices; should the war end this month even next year's earnings would reflect the present abnormal conditions. And the end is nowhere in sight.

Invents Mine Car

A patent covering the invention of a mine car was recently assigned to the American Car & Foundry Co., St. Louis, by Warren V. Johnston, Bloomsburg, Pa. The wooden floor of the car extends through and beyond the body portion and is reinforced by heavy wooden bumper blocks on either end. The floor and blocks are covered with metal bands. If desired, metal floors may be substituted. A heavy draw bar, extending through the car, is bolted to the central floor board. The ends of the bar are punched and offset, providing a means of coupling adjacent cars. The side sheets, end sheets and end doors, are made of thin corrugated sheet metal. Channel-shaped body bands are riveted to the side sheets and bolted to the wooden floor, forming in this manner a removable attachment, connecting the side sheets with the floor. Angle irons, running from end to end of the car, likewise serve the same purpose. Corrugated iron strips are riveted to the side sheets at right angles, angle irons being used on the corners. At one end of the car a dumping door of corrugated sheet steel is hung on a roller bar by hinge straps. An eye bolt, bolted to the floor, is provided with a link which in turn is riveted to the floor, enabling, in this manner, the end of a latch bolted to the door, to pass through the loop made by the staple fitting over the link. This secures the door firmly. The brake blocks are controled from the opposite end of the car, and are applied to the wheels by means of a ratchet arm. Journal boxes are held in line by the horizontal flange of the angle iron. It is claimed that this mine car, constructed of wood and corrugated iron strips, is not only strong and durable enough, but that it also has the elasticity which is so necessary in a mine car to allow it to resist severe service shocks.

England in Second Year of War

Memorable Period for the Iron and Steel Industries—Effects of Government Control of Properties and Prices—Some Extremely Interesting Features

BY JOSEPH HORTON
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THE second complete year of war has been a memorable period; first, because of the revolutionary conditions under which the iron and steel industry has been carried on, and still more because these conditions have accelerated the extraordinary progress begun in the early days of the war. Precise details of development, of course, are not available, and even if the facts were known, they could not now be made public. But it will eventually be found that the war has given a huge stimulus to the steel trade, which will be manifest, on the return of peace, in establishments enormously enlarged, equipped to a vastly greater extent with up-to-date machinery, and generally qualified to take possession of a much larger share of the world's trade than was handled before the war. Where prices have been free to expand in response to economic conditions, they have soared to unprecedented heights. But prices are not a reliable criterion, for the reason that the government has kept a very tight hand upon them, and in doing so, since wages are regulated by sliding scale, has incidentally kept down wages also. Yet these also have touched new records, and the ironworker is likely to look back upon his earnings during 1916 as representing far and away the best wages of his life. Whether that proves to be the case, will depend upon whether the war survives 1917. On this point, strange as it may seem, there is less optimism than prevailed a year ago. Lloyd George was quite correct some time ago in stating that British people have "neither clock nor calendar". If possible, the determination to pursue the war to a victorious finish is stronger than at the end of 1915. But too many times prophecies have been falsified for any experiments in that direction to be made or received with any confidence.

PREPARATIONS for a vastly enlarged trade in the future are too numerous to mention. By way of self-help, capitalists and manufacturers have established a very large and thoroughly representative Federation of British Industries, intended to promote extension on the financial, commercial, political and international sides. Efforts are also to be made in the direction of securing within the empire supplies of essential material. The government is taking a new interest in questions of research and inquiry and special departments, with financial assistance, linked up with government administration, have been established. It is well known also that the iron and steel trade are giving their powerful support to a projected national bank intended to discharge such functions as are carried on with more or less success by German banks, in the way of financing new, and to a certain degree speculative enterprises.

Labor Conditions

Fortunately, the war providers have been much less embarrassed this year with labor troubles, partly, one is glad to recognize, because of a higher recognition of patriotic duty in the ranks of labor, though it must be conceded also that, generally speaking, workers of all grades have largely been placated by getting pretty well all they have asked for. The end of the year finds the labor question somewhat acute, in view of the continued very large demands of the army, and the fact that, to an increasing extent, industrial and financial assistance has to be given to our allies by Great Britain. A number of skilled workers have had to be brought back to the iron and steel works from the ranks, and it seems inevitable that further migrations of the same kind will be a feature of the coming year.

Even the trade has been astonished at the extraordinary patience with which the innumerable government interferences have been received, although these have practically revolutionized the conditions under which business has been carried on. The explanation, of course, is the full recognition, through the year, of the real nature of the peril threatening this country. The same spirit which has led our young men to sacrifice life and limb on the battlefield has enabled the business man practically to relinquish the control of his own concern and, if necessary, Englishmen are prepared to go even further in the same direction.

The great demand and extraordinary conditions prevailing in the pig iron department of the industry have by no means been reflected in the prices, because these have been rigidly controled by the government. Cleveland appears to have been the center of the sweeping changes, the two principal signs of which are the disappearance of the huge local stores, which in the past have had such a great influence upon trade volume and prices, and the almost complete abolition of the shipping business, which formerly made such a prominent figure in the board of trade returns. At the end of November, the Middlesbrough stores totaled 4,000 tons, as compared with 130,000 tons a year ago, and 142,000 two years ago. The greatest possible boon to the country at the present time would be ability to draw upon those mountains of pig iron, sometimes running up to a million tons, which were formerly such a feature in Cleveland. Throughout the year the judicious distribution of the metal available has been the work of a local expert committee, whose first business has been to see that urgent war demands are duly considered. That committee has succeeded to a remarkable extent in satisfying the parties chiefly concerned.

Government Runs Blast Furnaces

The first movement of the new year was the taking over by the government of the whole of the blast furnaces. Blast furnaces were left uncontroled long after hundreds of works

making war material had been taken over. To the credit of the government be it said, long consultations with the trade preceded this assumption of the reins of government and the fixing of prices.

The one merit of the system of government control has been that the minister of munitions has all along endeavored to give proper consideration to the views of the parties interested; and the fullest information has been obtained as to cost of production affecting material, wages and local conditions. While the result has left a good deal to be desired, and has repeatedly developed extraordinary anomalies, iron masters have given the authorities full credit for the best possible intentions in the measures taken. Prices were advancing rapidly when peremptorily arrested by the intervention of the government. The formal controling of blast furnaces preceded by some months the definite publication of maximum prices, and it was at the beginning of April that the first list was issued. But by a private understanding with the ministry sales were on the restricted rates some time before the publication of the authorized rates. The following is the first list published at the beginning of April, determining selling prices until June 30 on grades named as follows, the usual differentials prevailing in other grades:

Hematite pig iron, West Coast:—Mixed numbers 1, 2 and 3, £6 7s 6d ($30.60) per ton net.

Hematite pig iron, East Coast—Mixed numbers 1, 2 and 3, £6 2s 6d ($29.60).

Cleveland pig iron—Mixed numbers 1, 2 and 3, £4 2s 6d ($19.80).

Northamptonshire pig iron—Forge, £4 2s 6d ($19.80), ditto foundry numbers, £4 5s ($20.40)

How Maximum Prices Worked

The list was loyally accepted and adhered to by smelters in the Midlands, but complaints very soon arose, mainly because of the very substantial increase in the cost of production which followed almost immediately after the settlement of prices. An advance of 15 per cent in the wages of Welsh colliers made a very material addition to furnace expenditure, and when the ministry of munitions allowed coke makers to increase their charges 1s 6d (36c) per ton, it was estimated that 3s (72c) more had been added by this alone to the cost of pig iron production. At that time of the year coke was very scarce, and production was undoubtedly restricted on that account. The agitation which then commenced for a rise in the maximums was only partially successful. A good deal more liberty seems to have been taken in Cleveland where prices were reported to be from $1.20 to $2.40 above the maximum figure. Cleveland iron, in fact, went on advancing for some time after the declaration of the government maximum, and one of the remarkable episodes of the year was a sudden collapse in Cleveland prices, which throughout February and March had continued to advance. Before the arrest became really effective in that district, prices had reached an altitude not experienced for 50 years. When 97s 6d ($23.40) was reached, a fall of 18s ($2.40) took place in a single day through, it is stated, an official intimation that the maximum would be insisted upon.

Many Operating Troubles

The demand for steelmaking irons throughout the year has been immense, and in September it was reported that all the producers were fully sold up to Christmas. The furnaces on the West Coast producing high class iron have been working at the highest possible pressure, mainly because of their share in naval shipbuilding, the production of shell steel, etc. For several months past, there has been constant talk of new furnaces being started up, but nothing substantial has been done, chiefly because of the scarcity of labor. It seems to have been very much easier to get the men into the army than to get them back again, and the production of pig iron seems to have been beset with every kind of difficulty. There has been railway congestion, a run of exceptionally wet weather reducing the heating power of the fuel, less efficient coke making, and an abandonment, at many pits, of the thoroughgoing screening and preparation of fuel customary in peace time.

Later on, of course, the government met the situation by placing much tighter restrictions on exports, and the tightening up has been so effectual that the authorities now know all about the character and ultimate destination of every parcel of pig iron going out of the country.

At the end of the year one hears nothing of those excited flights of prices which during boom years have been a feature of the Cleveland market, and in the first month or two was affording its customary opportunities and attractions to the speculative adventurer—shopman, tradesman, small property owner and what not. These enterprising adventurers have long since disappeared from the market, decidedly for the general advantage, and there will be no lamentation if in future the "cobbler sticks to his last", and leaves the iron business to people who understand it.

The agitation for higher prices continued uninterruptedly almost from the date of the issue of the above list, but produced very little effect, and the changes have been trifling.

Broadly speaking, the government has gone on the principle of keeping as tight a hand as possible on prices, especially of raw material, realizing that concessions to one branch, for example, to makers of coke or pig iron, inevitably led to further demands from those engaged in subsequent processes.

Finished Iron Prices

In regard to finished iron the progress of prices is usefully indicated by the official returns for the wages board, which not only give actual selling figures at the end of every bimonthly period, but fix the wages for the ensuing two months. The first record issued by the Midland wages board at the end of January dealt with November and December of the previous year, showing an average selling price of £11 4s 4d ($53.84) as compared with £10 8s 8d ($50.08) the previous two months. This gave the men a rise of 7½ per cent and fixed the puddling rate at 14s ($3.36) per ton. For January and February, the average was £12 3s 11d($58.54), the men received a 10 per cent advance and puddlers 15s ($3.68). For March and April the average was £13 11d ($62.62), the men taking another 7½ per cent and puddlers earning 15s 9d ($3.78). In May and June the average was £13 13s 11d ($65.74), there was another rise of 7½ per cent in wages and the puddling rate was lifted to 16s 6d ($3.96) per ton. For the ensuing two months of July and August, the average was £14 2s 2d ($67.72) and the men took another 2½ per cent advance. The smaller rate of progress is due to the fact that government restrictions on prices by this time were beginning to have a marked effect. The returns for September and October, which will be published in a few days, will probably give a slight advance, but the rate of progression has been steadied considerably. In the north of England the men have received five successive advances giving them a rise of 32½ per cent in 12 months. Wages both in the north and the Midlands have reached a highwater mark never previously touched. In fact all records have been left far in the rear. Extraordinary stories are published occasionally as to the men's earnings. One large employer stated before the Sheffield munitions tribunal that some of his men were earning £20

per week. Four or five pounds to 10 pounds per week was a very common experience. Labor in the iron and steel trades just now holds a very commanding position, a fact of which their employes are fully aware.

The office of the minister of munitions definitely extended control to finished iron early in the year, and it was with its sanction that an advance of 30s ($7.20) in marked bars took place at the beginning of March. Other advances have been declared with the result that marked bars which stood at £13 10s ($64.80) in January were £15 10s ($74.40) less 2½ per cent at the end of November. It is unnecessary to follow the detailed progress of other descriptions but unmarked bars have advanced from £13 5s ($63.60) to £13 15s ($66), gas strip from £13 5s ($63.60) to £15 ($72), hoops and strip, iron and steel from £16 ($76.80) to £18 10 s ($88.40), galvanized sheets from £25 ($120) to £28 10s ($136.80).

Guides for Zeppelins

In the earlier part of the year the scares arising from air raids led to a temporary slacking down of blast in danger areas, when raids were thought to be imminent; but it was soon realized that the game was not worth the candle, in view of the vast importance of metal production in relation to the prosecution of the war, and it is understood that the practice for a long time past has been to ignore possible Zeppelin dangers. All the same, there seems no doubt that the partial successes attending earlier Zeppelin raids were assisted by the flare of certain furnaces in the Midlands.

Importance of Steel

From the war point of view, steel is much more important than iron. The scarcity of steel of all kinds has been constantly pronounced and early in April the government found it necessary to prohibit the export of steel ingots, blooms, billets, etc., except under its own sanction and supervision. This has proved an important exception, as fairly large quantities of this material are called for by our allies. Throughout the year, there has been great scarcity of basic steel for general purposes, and in this department the enormous reduction in imports from America has been severely felt. Throughout the greater part of last year, this country took about 30,000 tons per month of steel from America. By April this year the importation had fallen to 6,000 tons. Latterly it seems to be approaching the vanishing point. A good deal of firmness has been manifested by the government with regard to steel billets which still stand at the official figure of £10 7s 6d ($49.80). For sales outside government purposes, which have special sanction, as much as £14 ($67.20) can be got. But this low figure has naturally in itself helped to discourage the production of half-finished steel. Undoubtedly the greatest trouble in meeting by importation the demands for steel arises from the enormous freight charges, now approximately £7 ($33.60) per ton. It is a mere commonplace to say that all ordinary uses of steel are practically in suspense. Wire rods have reached the high price of £21 ($100.80) per ton for American material. Every month has seen a rise in American billets and a recent quotation was £15 ($72) to £15 10s ($74.80). Early in the year it was possible to buy them at £12 10s ($60), and the merchants able to secure American heavy ingots for £11 10s ($55.20) considered themselves very fortunate. A small amount of discard steel can be bought at rather high figures. Probably the only American steel now coming into the country worth mentioning is wire rods, as English material seems to be unobtainable.

Sheets and Tin Plate

Among the industries which have suffered most from the war have been those of galvanized sheets and tin plates. In these departments, Englishmenn are very well aware that their American cousins have been profiting at their expense. The galvanized sheet business has nearly disappeared, and if the English sheetmaker had not gone beyond the emotional stage, as the result of 2½ years of war, he would be very much disturbed at the spectacle of his trade drifting into the hands of America. We have learned to take all these experiences philosophically. The great scarcity of sheet bars and the high price of spelter have combined to force sheet values to an unsaleable point. A certain tonnage of painted sheets is being sold for people not obsessed with the idea of zinc protection. But it is freely conceded that up to the present no adequate substitute for galvanizing has been devised. The tin plate trade similarly has been cut down to about half by government prohibitions and discouragements of productions having no direct bearing on the war.

The record of company results shows that, with all their difficulties and inflated costs of production, manufacturers have no reason to complain of poor profits. Share values and dividends show a remarkable increase. Guest, Keen & Nettleford paid 15 per cent; Staveley Coal & Iron Co., 20 per cent; Bolckow, Vaughan & Co., 11 per cent; Pearson & Knowles, 15 per cent; Steel Co. of Scotland, 10 per cent; Armstrong Whitworth, 10 per cent; and others paid equally large amounts after substantial deductions by the government in respect of excess profits duty.

The Future

It is obviously difficult to make any forecast with regard to the future. So much depends upon the duration of the war. But the imperious demand by the government for nearly all the steel produced is a fact of outstanding importance. Nearly all other uses for steel are in suspense. Ship building is very largely reduced, especially for mercantile requirements. Railways in all directions call for renewals. Constructive engineering outside war machinery, implements, factories, etc., is practically suspended. Some iron and steel using industries have nearly become extinct for the time being. All this points to a vast demand for iron and steel after the war. From this point of view, manufacturers and traders realize that the government control of prices will to some extent alleviate the backward swing which must follow the cessation of war demands, and this is felt to be a compensating advantage for much of the present irritation and annoyances. Such provision has been made by organization, intelligent control of industry, provision for research, the training of commercial and technical experts, as will, it is believed, enable the British iron and steel industry to take full advantage of the return to pacific conditions.

Steel and the Nation

One of the effects of the war has been to arouse the nation to a more adequate recognition of the vital importance of the steel trade to national and imperial existence, and this recognition must have far-reaching results. One of the most interesting developments has been a series of confessions of faith from leading politicians and business men, the general effect of which is to show that old ideas on fiscal and economic questions have been largely abandoned, and though we have not yet had a categorical assurance to that effect, it is generally believed, that a more or less binding guarantee was given British steelmakers, before they undertook the enormous capital expenditure required for works extension that they will in future be protected from the ruthless competition of cheaply made and bounty-fed foreign steel.

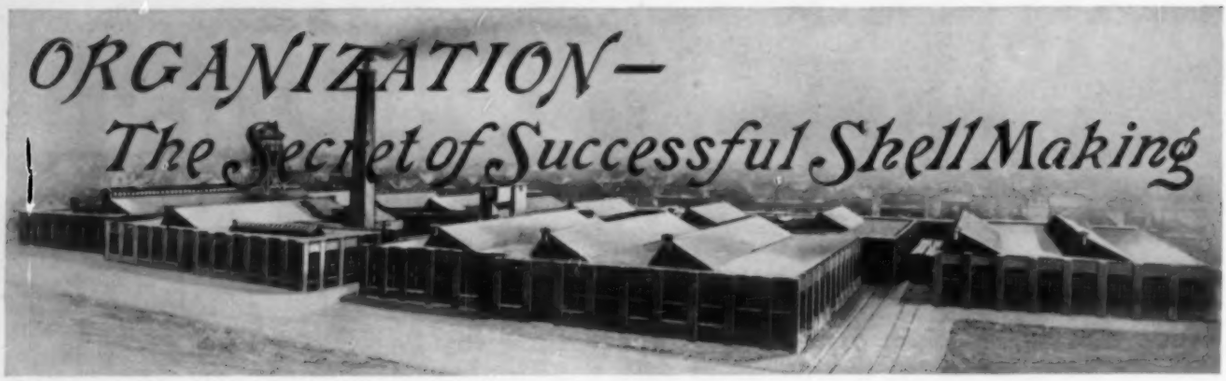
Getting Up to Speed
IN A
Munitions Plant

How the Symington Machine Corporation Built Up Its Shrapnel Production from Nothing to Three Hundred Thousand Per Month

A true story of how an original idea, a determination to more than fulfill the requirements specified, and a wonderful spirit of co-operation brought success to one of many companies that have taken a whirl at the business of making munitions.

The Men are at the Plant Ahead of Time

ORGANIZATION—The Secret of Successful Shell Making



ABILITY to produce munitions—the priceless asset of a nation in war, is seldom developed in time of peace. The opportunity to gain experience in organizing industry for military emergency usually comes after war is declared. Not often is the lesson of preparedness to be had for the asking.

As education is forced upon an unappreciative child, martial necessity in Europe has imposed on America the task of providing its armies with the materials of war. An experience pregnant with unlimited possibilities is thrust upon us. Do we recognize its potential value?

We have approved the principle of industrial organization, and we have gone so far as to take an inventory of the resources of the nation for producing military necessities, but we have done nothing to actually develop the ability to adequately provide for war. Official Washington, apparently, is willing that the munitions-making capacity of the country be limited, virtually to the government arsenals. In congress the boast has been made that the nation is independent of privately owned munitions plants. In peace, private enterprise has been frowned upon; in war its plants are expected to come to the rescue of the country. Truly, the value of the experience America is now gaining from Europe is priceless and should be appreciated.

Notwithstanding the situation just outlined, American manufacturers are fast building up organizations for producing military materials. Although they were attracted to the business by the uncertain profits of war orders, they are nevertheless engaged in a work in which the experience gained will be of unmeasurable benefit to the country. They are developing the greatest weapon a warring power can possess—an efficient organization for producing munitions.

The story of munitions making in America reads like a fairy tale. Soon after the powers of Europe became embroiled in the present conflict, manufacturers in this country began to comprehend the commercial possibilities of the war. When the first large orders were brought to this country by J. P. Morgan and Chas. M. Schwab, New York went war mad. Owners of manufacturing plants were urged to get into the shell business. The belief spread that anyone with a few machines could amass millions by turning out shrapnel for the allies. Many were the susceptible companies that were swept into the shell game without investigating its pitfalls. The promised riches for many were not realized; a few lost heavily; others came through with flying colors.

Among the manufacturers who refused to bite at the tempting orders offered in the beginning of 1915 were the Symington brothers—T. H., Donald and C. J.—of Rochester, N. Y. Besieged on all sides by friends advising them to get in on the ground floor and share in the immense profits of the muni-

(*Continued on page 62*)

T. H. SYMINGTON DONALD SYMINGTON C. J. SYMINGTON

Machining the Shell Forgings

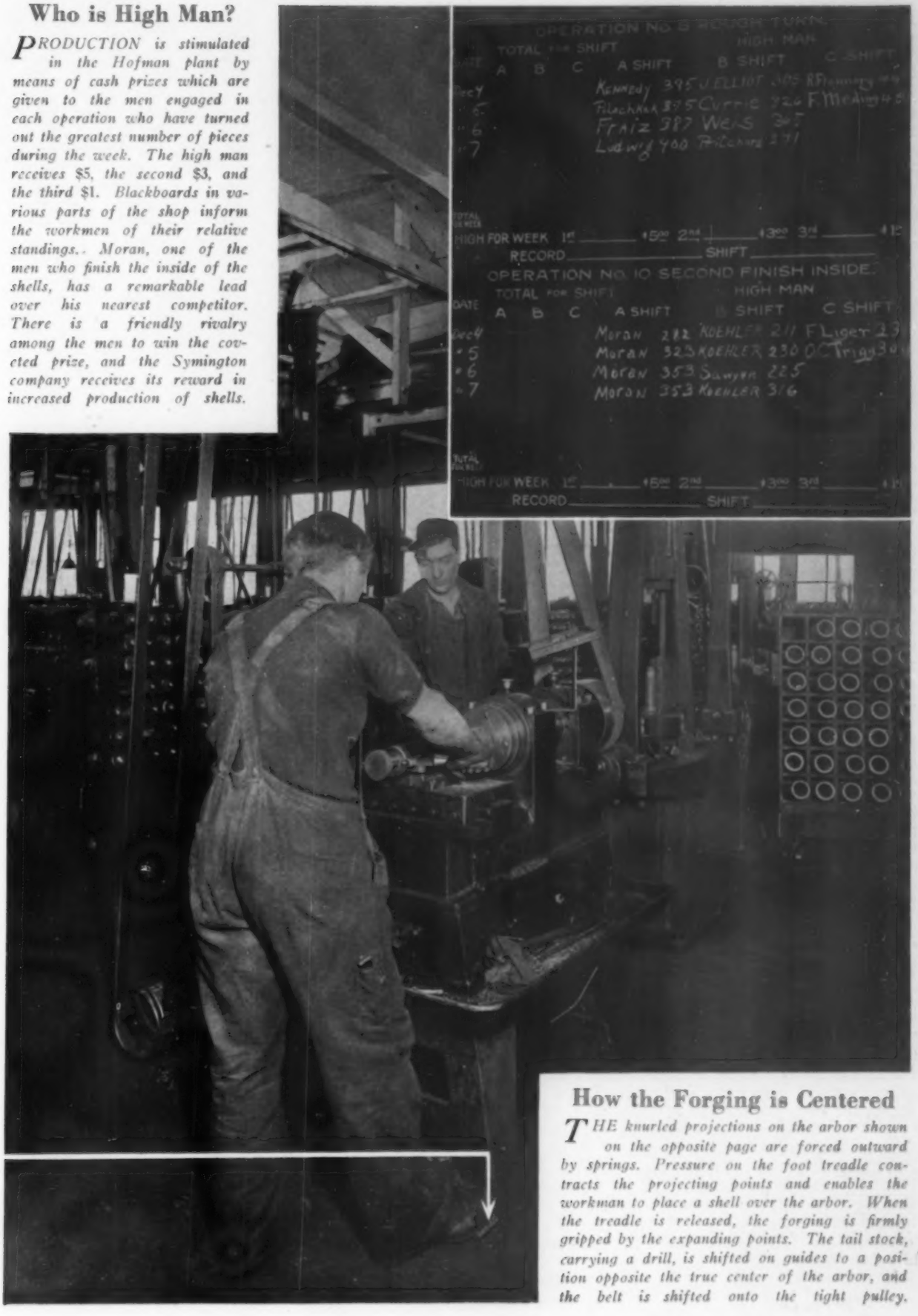
CUTTING off the ends of the forgings is the first machine operation in shell making. The length is measured from the inside, the sliding rod in the tail stock being used to push the forging just far enough into the chuck so that the tool will cut the shell to the proper length. All machines in the Symington plant are driven by belts from main shafts. The elimination of countershafts reduces the number of pulleys and amount of belting required and simplifies the transfer of one or more machines from place to place.

"Nicking" the Shells

"HOW shall we chuck the forgings?" That was the problem of pioneer munition makers in America. The Symington company eliminates chucking, centering and driving difficulties by nicking the inner edge of the open end of the forging. The lathe spindles are fitted with a cone-shaped center containing projections which engage the nicks in the shell. This method of driving decreases to a minimum the number of forgings rejected on account of eccentricity and permits the use of heavy cuts and feeds for the first rough-turning operation. The accompanying illustration shows a machine for nicking shells.

Who is High Man?

PRODUCTION is stimulated in the Hofman plant by means of cash prizes which are given to the men engaged in each operation who have turned out the greatest number of pieces during the week. The high man receives $5, the second $3, and the third $1. Blackboards in various parts of the shop inform the workmen of their relative standings. Moran, one of the men who finish the inside of the shells, has a remarkable lead over his nearest competitor. There is a friendly rivalry among the men to win the coveted prize, and the Symington company receives its reward in increased production of shells.



How the Forging is Centered

THE knurled projections on the arbor shown on the opposite page are forced outward by springs. Pressure on the foot treadle contracts the projecting points and enables the workman to place a shell over the arbor. When the treadle is released, the forging is firmly gripped by the expanding points. The tail stock, carrying a drill, is shifted on guides to a position opposite the true center of the arbor, and the belt is shifted onto the tight pulley.

(*Continued from page* 58)

tions business, these men waited. They were not swayed by the war fever.

A few months later American work shops were buckling down to the war game. Everybody was looking for machinery and material A mere fraction of the manufacturers in the shell business knew what machines they required. Few could get prompt deliveries. All were paying fabulous prices. Lathes were in great demand. Prices had tripled.

Then, T. H. Symington concluded that the great need of the munitions business was heavily built single purpose machines—machines that an inexperienced man could operate, machines that would stand a terrific pace. Impressed with the possibilities of the idea, he hurried to Rochester and gathered together a force of engineers who helped him design and build eight experimental shell-making machines, which were immediately scrapped. In a short time a plant for assembling the machines was in operation. The forgings, castings and other parts came from jobbing foundries and machine shops in many parts of the country. The design simplified the work of machining, and as a result, the manufacturing processes went forward with a rush. Soon Russian, Italian, Australian, Canadian and American shell manufacturers were buying from the Symingtons. They sold more than a million dollars worth of machines. Then came the thought, "If we have the machines, why not make the shells?" The possibilities of the idea grew. Increasing enthusiasm induced prompt action, and in September, 1915, the Symington brothers bought the former wood-working shop, now one of the most widely-known shell-making plants in the United States. The buildings were of brick and wood, and were not especially adapted to a large manufacturing business. Plans for extensive improvements and radical changes were hurriedly drawn up, and put into execution. While the contractors were doubling the size of the plant, engineers were working out the plans for the arrangement of equipment. Shafting, belting, power supply, fuel for furnaces, shipping facilities—in fact, a countless number of details were encountered.

THE HAND TRUCK—A NECESSITY IN A SHELL-MAKING PLANT

Early in 1916 the plant was ready. Then began the long tedious task of perfecting an organization. Each of the many operations had to be worked out. The executive heads of the company worked day and night on the details. Several superintendents were tried, but did not measure up to the requirements of the job. Unforeseen difficulties arose with fiendish frequency. Several times it seemed as if all possible expedients had been exhausted. All of this happened during the first few months of 1916.

Late in March the outline of an organization for shell making began to take form. In April the outlook was brighter. Twenty-seven shells, the first fruit of months of hardest work, were delivered. To the Rochester manufacturers came the comforting consciousness that at last they knew *how* to make shells. They still faced the problem of how to make *many* shells.

It was soon evident that this was a question of organization. Every operation must be systematized under the direction of a competent sub-foreman. Each department must be supervised by an able foreman. The three shifts must work in harmony, and all foremen must co-operate in directing the work under the supervision of the superintendent.

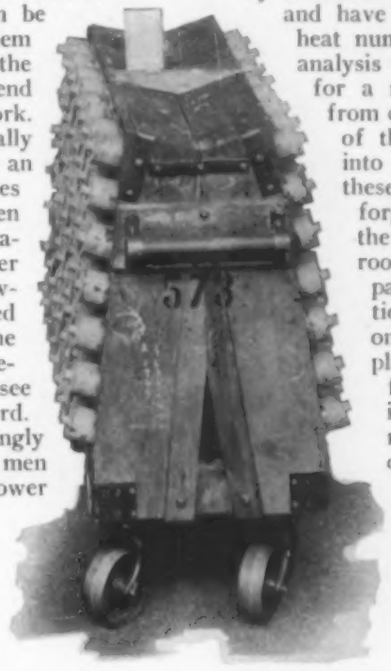
Naturally the first step was to secure operators for the machines. In spite of the well-known scarcity of labor this proved to be no problem at all. Doctors, clergymen, editors, clerks, street car conductors, motormen, dairymen, farmers, delivery boys, messengers, mail clerks—men from every trade rushed to the doors of the Symington plant to make shells. Repairmen from automobile garages, machine shops, and smaller plants, became good toolmakers. Others with natural executive ability and a fair knowledge of machines and shop practice were developed into competent subforemen. Department heads were harder to find, but as the organization grew, they were gradually secured from other establishments. C. F. Morley, the superintendent of the plant, and the man who with T. H. Symington worked out the entire organization, came from a jobbing machine shop of his own, joined the Symington force when the shell plant was in its infancy, and worked his way to the top. With a smooth-working organization becoming more efficient every day, the problem of building up production was simplified. From the 27 shells delivered in April, the monthly production grew to 2,000 in May, 31,000 in June, 110,000 in July, 147,000 in August, 225,000 in September, 281,000 in October and 328,000 in November. The specifications in the contracts regarding the delivery of shells are being followed to the letter. Another reason for the success of the Rochester firm's organization is the harmonious spirit that prevails among all of the 2,500 employes. This co-operation is not accidental. It is the outcome of careful planning in which the fundamentals of the labor question have been considered fully and in detail. First of all, the scheme of operation is such that every man feels that his efforts contribute to the efficiency of the plant. Adequate supervision is largely responsible for this, there being a sub-foreman for approximately every 20 men. The sub-foremen and departmental heads on the day shift are directly responsible to the superintendent. The supervisors of the night forces report to the corresponding men on the day force. Daily conferences between the night foremen and the superintendent are held to foster the spirit of co-operation and to further the bonds of perfect agreement relating to the policies of supervision.

Loyalty to the company is encouraged by a unique bonus system in which the sub-foremen, foremen, and other officers up to and including the superintendent, participate. At the beginning of each month an arbitrary rate of production for the month is decided upon at a meeting of the foremen. If the planned figure is equaled in actual output, a certain predecided bonus is paid. The amount of this reward is based on the salaries of the various men who participate in the division of the money. If production falls below the stipulated figure, the amount of the bonus

is decreased; if it exceeds it, the dividend increases in proportion.

Nor is the bonus limited to the foremen in charge of the productive departments of the plant. The tool room foremen, the head of the heat-treating department, the chief electrician, foreman of the machine-repair gang, and all of the other supervisory officers whose work in any way contributes to the smooth working efficiency of the organization receive a portion of the reward.

The result of this plan has been more gratifying than was first anticipated. Every man has taken a personal interest in the work. He feels that his little part in the great plan of production is vital to the collective result. If production falls down, he feels that he has been partly to blame. When the estimated output is exceeded he properly assumes his share of the credit. The bonus system has directed the attention of the entire force of foremen to the question of the hour: What can be done to make more shells, make them better, and for less money? But the reward for good service does not end with the men who supervise the work. The men on the machines, who actually turn out the work, are likewise given an incentive to greater efforts. Prizes ranging from $5 down to $1 are given to the three men engaged in each operation who turn out the greatest number of shells each week. Blackboards showing the standing of the men are posted in convenient places throughout the plant, and a merry rivalry exists between the competing operators to see who can achieve a new high record. The direct benefit of this plan is strikingly in evidence at lunch time, when the men are given a 20-minute recess. The power is shut off soon after the quitting gong rings, and a person who witnesses two or three of these lunch periods cannot help but be impressed with the attitude of the men. Instead of rushing from their machines at the first tap of the bell, the operators stick to the job until the cut on the work in the machine is finished. Visitors in the shop are inclined to think that if the power was not shut off, some of the men would entirely neglect the recess for lunch. The same characteristic interest in the work is displayed just before the recess is over. Before the motors are started, many of the men change tools, make adjustments, or do other minor jobs which add to their ability to turn out more work. There is almost a feverish eagerness to make every minute count.



EACH SIDE OF THE TRUCK HAS COMPARTMENTS FOR 56 SHELLS

However, the spirit of co-operation cannot be measured entirely from the evidence revealed in the plant. It extends into every corner of the city of Rochester. The spirit of the plant has become a real tangible something that gets into the city papers, is carried into the social life of the town, and exists on the streets. Its imprint is found in the hotels where banquets for Symington employes are given; in the theaters where the workmen get together in theater parties; in the newspapers where their social events are recorded as well as on the street and elsewhere. What has the company to offer in equipment, in system and resources to consume the energies of this enthusiastic army? Is this tremendous wealth of good will utilized in making shells? Is any of it lost because of inefficiency?

One glance at the inside of the Hofman works of the Symington Machine Corporation is sufficient to dispel any doubt as to the real effectiveness of the system. The forgings seem to pass from the rough to the finished state with clocklike precision. Time-saving devices are everywhere. Labor is economized wherever possible. Useless steps are avoided. Inefficiency is abhored.

The forgings arrive from the makers in cars at the south end of the plant. As they are unloaded they are carefully piled in the storage yard in groups according to the heat number stamped or stenciled on each piece. They are brought into the plant in three-wheeled trucks which have 56 compartments on each side. These trucks, which were manufactured by the Lansing Co., Lansing, Mich., are numbered, and have a case for a card which shows the heat number, a symbolic key to the chemical analysis of the forging. The card has spaces for a record of the forgings as they pass from one operation to another. The progress of the shell through the plant is divided into three distinct parts. The first of these, known as the "up line", takes the forging from the time it is received in the plant until it reaches the heat-treating room. The partly machined shell then passes through the three separate operations in heat-treating, which is the second part of its journey through the plant. The heat-treated shrapnel then follows the "down line", which takes it from the furnaces to the inspection room. The work passes in rapid succession from the cut-off machines, which perform the first machining operation, to the centering, nicking and rough-turning machines, which are pictured and described on the accompanying pages. All of these machines embody the principle of heavy bearings, simple lines and extra strength. The machines are worked at their maximum capacity, with less than an hour's rest in each day of 24 hours. In spite of this hard usage, repairs are not a heavy burden, principally because a system for maintaining the machines in first-class condition has been devised.

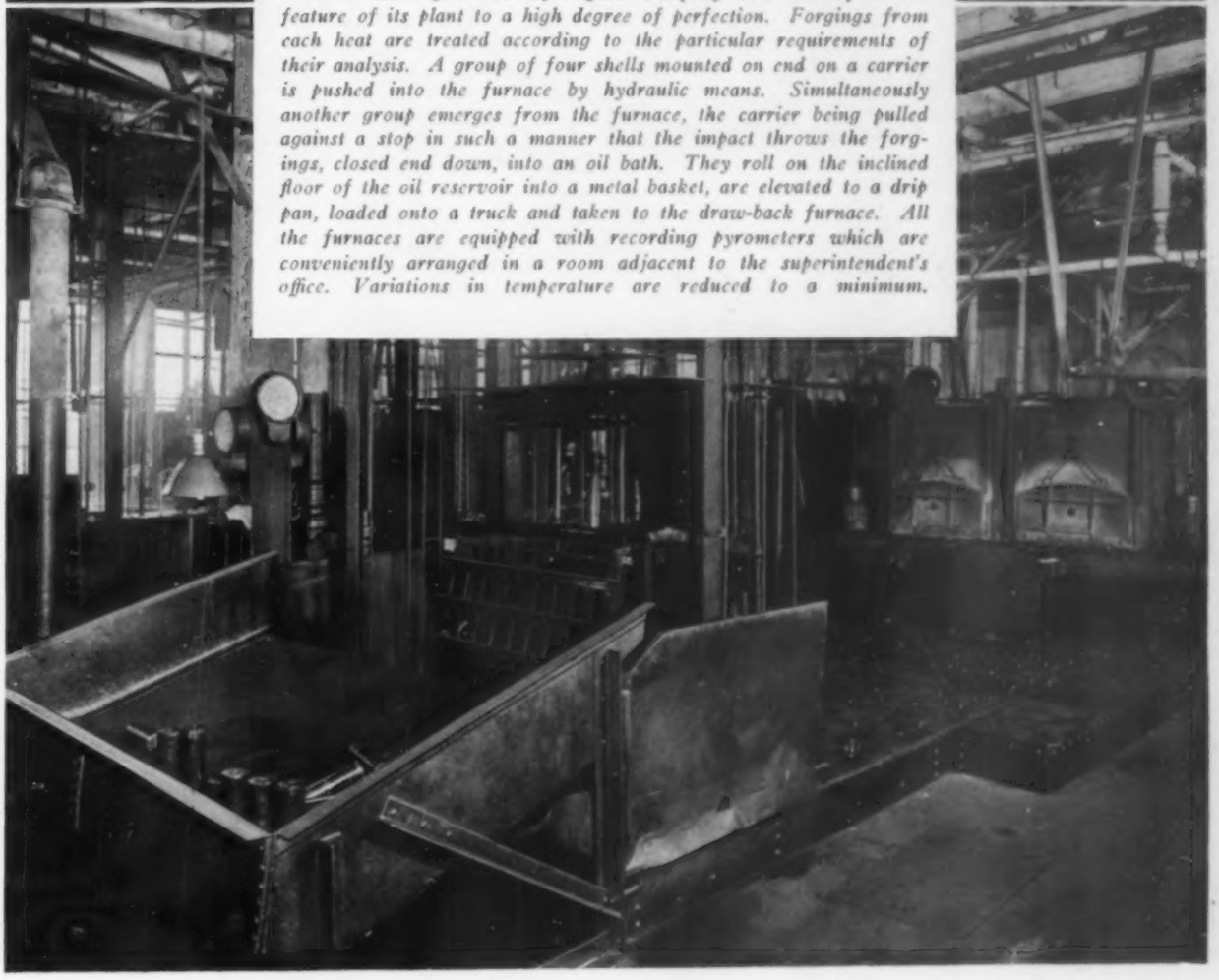
When a machine becomes unfit for service, it is promptly inspected by a man from the machine repair department. Unless the repairs are of a trivial nature, the belt is thrown off, the anchor bolts removed and the machine placed on a truck and hauled to the repair shop. If necessary to keep the production up to requirements in this group of machines, another machine replaces the one that is out of commission.

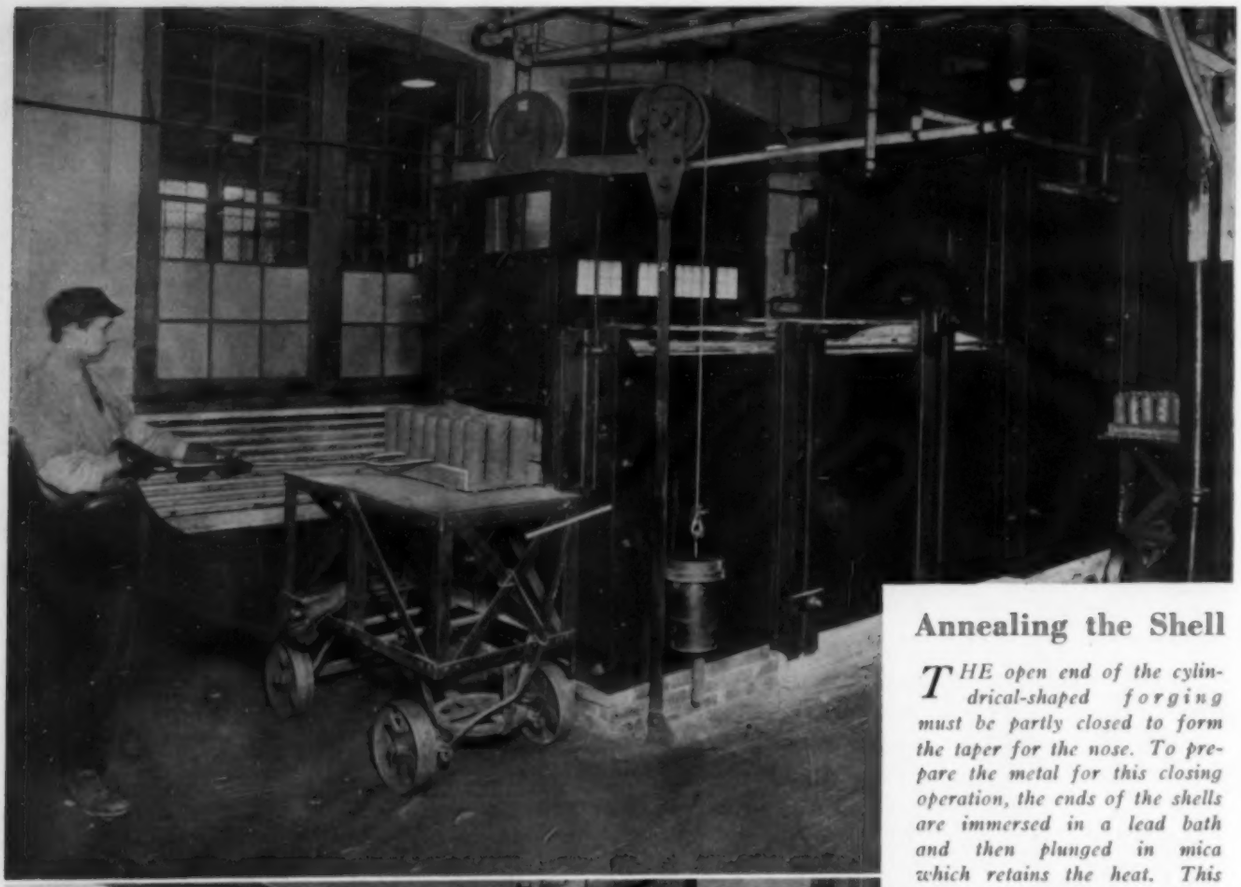
Repairs in the repair shop are simplified by the standard design of the machines. For instance, if a single-purpose lathe comes in to have the jaws of the chuck trued up, it is a simple matter to lift the solid spindle and chuck into a standard pair of bearings mounted on a lathe bed on which a small grinding wheel driven by an individual motor is fixed. The chuck is driven by the belt of the machine while the emery wheel is driven by the small motor. The

(*Continued on page* 68)

Heat Treating is Important

INTELLIGENT heat treatment is one of the essentials of good shell making. The Symington company has developed this feature of its plant to a high degree of perfection. Forgings from each heat are treated according to the particular requirements of their analysis. A group of four shells mounted on end on a carrier is pushed into the furnace by hydraulic means. Simultaneously another group emerges from the furnace, the carrier being pulled against a stop in such a manner that the impact throws the forgings, closed end down, into an oil bath. They roll on the inclined floor of the oil reservoir into a metal basket, are elevated to a drip pan, loaded onto a truck and taken to the draw-back furnace. All the furnaces are equipped with recording pyrometers which are conveniently arranged in a room adjacent to the superintendent's office. Variations in temperature are reduced to a minimum.





Annealing the Shell

THE open end of the cylindrical-shaped forging must be partly closed to form the taper for the nose. To prepare the metal for this closing operation, the ends of the shells are immersed in a lead bath and then plunged in mica which retains the heat. This process, together with the toughening influence of the draw-back treatment, makes the metal strong and tenacious, enabling it to successfully undergo heavy mechanical strain without further heating. The accompanying illustration shows the annealing furnaces and cooling table.

Washing the Machined Shell

IN the process of machining, shrapnel forgings accumulate a coating of cutting compound, oil, grease, etc., which must be removed before the shells are inspected. The cleaning is accomplished by forcing a hot cleansing mixture through short pipes up into the inverted shells. The open-ended vertical pipes are arranged in a single row in a long, narrow basin. Each battery of four is controled by a single valve which regulates the flow of the washing liquid. This simple arrangement has made it possible for four or five men on each of three shifts to thoroughly wash from 12,000 to 18,000 shells per day.

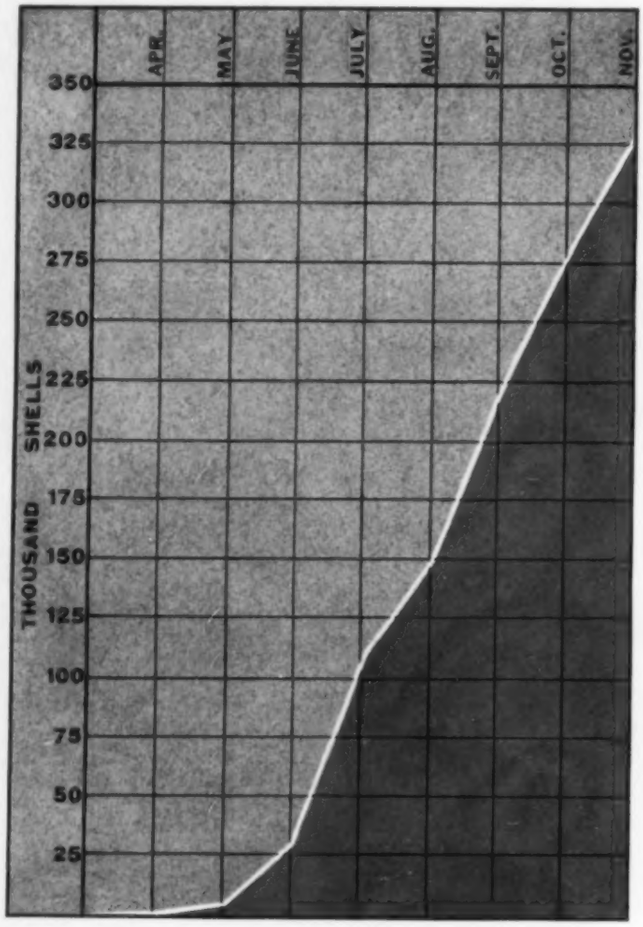
"Nosing" the Open End

AFTER most of the machining of a shell has been completed it is placed in a nosing press which partly closes the open end. This operation is performed on a heavy stamping press and the metal is pressed cold. The success with which this method has been accompanied in the Symington plant is evidence of the remarkable physical qualities of the heat-treated metal. After the shell has been nosed it is bored and tapped for the fuse socket fit. The bourrelet, the point of greatest diameter on the finished forging, is then accurately ground, and the base of the shell machined. This includes forming a radius on the tower edge of the shell and cutting a groove for the band.

(*Continued from page 63*)

jaws may be trued up in a few minutes; the bearings unclamped; the spindle and chuck removed; and the job is completed with the exception of reassembling the machine.

When a motor driving a line shaft breaks down, or when a motor becomes overloaded, the men working on the bay are not sent home until a new motor can be put in place. An emergency 25-horsepower Fairbanks-Morse motor, mounted on a truck is brought to the scene of trouble. The truck is firmly fastened to the floor by lag screws; a belt is thrown over a pulley on the line shaft; the motor is connected to a convenient power line by means of the armored cable carried with the outfit; the current is turned on; the switch on the controler is closed, and the emergency motor is ready for duty. The elapsed time, from the moment a motor breaks down until the load is taken by the emergency unit is less than 15 minutes. This improvised device reduced the total time lost on account of motor troubles for the past year to 52 minutes—an enviable record. Less significant machine and motor troubles are remedied with a minimum disturbing effect upon operations. Push buttons located at convenient points about the plant provide a means of summoning an electrician when he is needed. Devices of this kind, many of which are to be found in the Symington institution, save footsteps. They contribute to the general efficiency of the organization. Not only steps, but movements are saved. An operator on any one of the machines on the "up line" or "down line" has only to reach to the truck at his side for the unfinished shells. A home-made cradle on the headstock serves as a convenient holder for the piece until the shell in the machine is finished. A *V* block near the tailstock holds the shrapnel while the operator stamps the heat number upon it. Wrenches, hammers, stencils and other tools have their assigned places—all arranged for the convenience of the worker. Laborers attend to the lubrication of the machine and carry away the chips; belt repairmen look after the belts and keep the shafting in good condition; and attendants keep the trucks of shells moving from machine to machine as they are needed. Every movement of the operator helps to turn out shrapnel.



GETTING UNDER WAY IN A HURRY

The Symington organization for making shells has been built up in less than a year. The production has increased from 27 to 328,000 per month—a record to be proud of

Efficiency, carried even to a higher degree, is maintained in the heat-treating department. Here the shells are placed upright, open end down, on trays which are pushed into the furnace by hydraulically operated plungers. The movement of the shells through the furnaces has been regulated so that each group of four remains in the furnace one hour and 20 minutes. An electric gong, operated by a motor-driven drum similar to those used for automatic electric signs, rings at intervals of 2½ minutes, notifying the operators on each battery of two furnaces that it is time to place another group of forgings in the furnace. The tray entering the furnace pushes the others ahead of it, and forces the last one out at the rear. A workman inserts the tongs of a rake into holes in the tray, gives a sharp pull, and the tray slides along smooth ways to a stop. The impact is just sufficient to toss the shells headlong into an 8,000-gallon tank of oil, maintained at a temperature of 120 degrees by an extensive circulating and refrigerating system. The trays go back to the front of the furnace on a link conveyor, while the shells roll down the inclined floor of the oil reservoir into a metal basket which is elevated by means of a clutch driven from a line shaft. The shells roll out of the inclined bottom of the basket into a dripping pan, from which they are lifted onto a truck and taken to the drawback furnaces. Here they are subjected to a temperature of from 1,050 to 1,200 degrees for a period of one hour and 40 minutes. The furnaces in the heat-treating room were built by the Metals Production Equipment Co., New York, successors to the Quigley Furnace & Foundry Co. The furnaces are equipped with recording pyrometers manufactured by the Taylor Instrument Cos., Rochester, N. Y.

The open ends of the shells are annealed in lead baths. Six shrapnel can be placed on each furnace, and they are left in the lead for about 10 minutes. It was found that charcoal placed on the lead does away with poisonous fumes and prevents it from adhering to the forgings. As the shells are removed from the bath they are placed in a basin containing mica, which retains the heat.

The machining of the shells is completed on the "down line" from the heat treating room. The powder pocket and inside wall of the shell are finish bored, the outside is finish turned, the solid end is faced and the center removed. Then the shell is

placed under the die of a stamping press which partly closes the nose. This operation is performed without previously heating the forging and is evidence of the remarkable toughness imparted to the metal in the heat-treating department. The forging is then bored and tapped for the fuse socket, and the bourrelet, the point of greatest diameter, is ground. A groove for the copper band is cut and undercut, and the seat of the groove is knurled to prevent the copper band from slipping when the spiral rifling of the gun barrel bites into the copper. All of the operations on the "down line" are carried out with the same degree of efficiency that characterizes the work on the "up line".

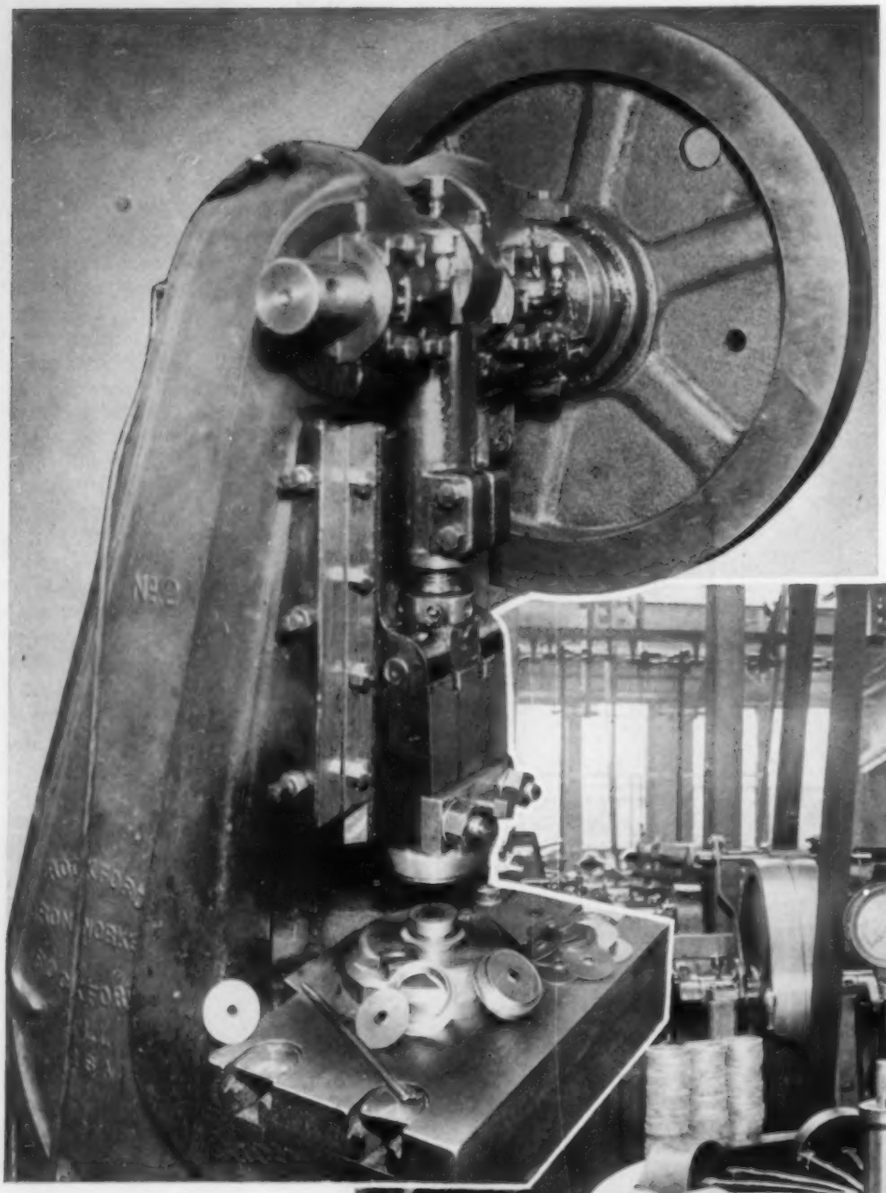
The fuse sockets, rings which fit into the open end of the shrapnel, present numerous difficulties to the shellmaker. The many different dimensions must be perfect, or the fuse and the shell will not fit. The inspection tests which the sockets undergo are unusually severe, and it is remarkable that any company has been able to turn them out with sufficient accuracy to permit of their being used interchangeably. The Symington company has been able to do this because it has devoted care and study to the method of doing the work. Speed lathes, forming tools, automatic dies, and single purpose machines were successfully brought into play in solving the problem. The inspection department in charge of the Russian commission is in a large, well-lighted room, containing long tables and equipped with portable miniature electric lights, which may be placed inside the shells to examine the interior. Since the Symington system provides for progressive inspection by employes of the company, very few defective shrapnel reach the inspectors for the Russian government. Rejections amount to about 0.5 per cent of the total number of shells submitted for inspection. This usually good record is due to the gradual elimination of defective shells during the machining processes. Whenever a shell is not passed by the company's inspectors in the production room, it is placed in a truck specially reserved for "reclaimed shells". A red card describing the defect accompanies the shell to the "shell hospital", as the reclaiming department is called. Here about a dozen men are engaged in curing the many ills that may overtake shrapnel in its journey through the plant. In some cases only a slight buffing of the surface will make the shell "O. K." Sometimes recentering will reclaim a forging. Frequently tool marks can be removed by careful filing or grinding. The efficiency of the shell hospital "staff" is such that 90 per cent of the "patients" are cured; only 10 per cent that come to the hospital go to the scrap pile—the shell cemetery.

C. F. MORLEY,
Superintendent of the Hofman munitions plant of the Symington company

After final inspection the shrapnel are given a thin coat of oil. In many munitions plants this is accomplished by dipping, painting, or some other laborious method. When the Symington plant was first placed in operation nearly a dozen men were engaged in oiling the shells preparatory to shipment. This expensive operation has since been replaced by a simple and ingenious device which enables one man to do the work. The shells are placed on two rolls wrapped with felt which are suspended over a basin of oil. The rolls are driven by a light belt from a line shaft, the oil-soaked felt leaving a thin film of oil on the surface of the shell. The oil is kept at a constant temperature by means of a steam pipe in the basin.

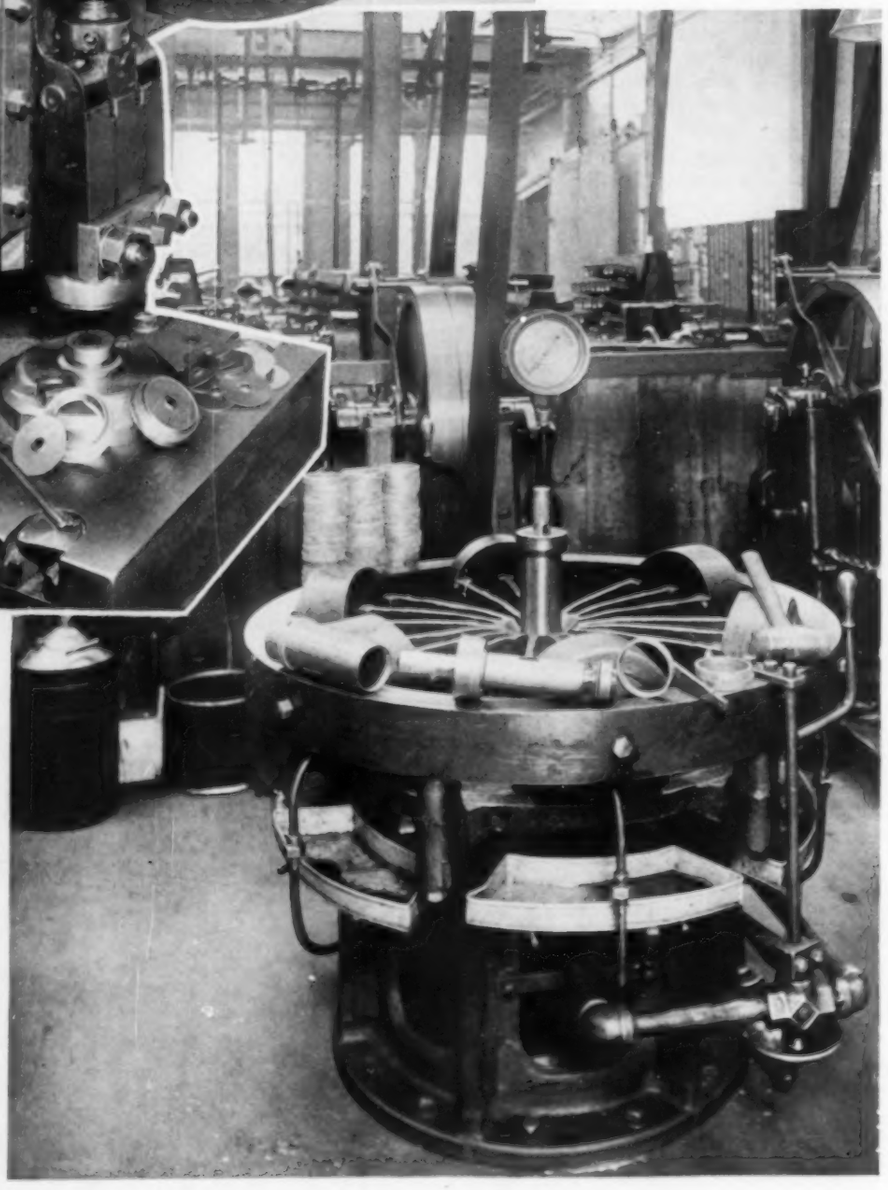
A systematic system of records goes hand in hand with operating efficiency. The progress of the work through the plant is summarized at the end of each shift so that the superintendent or his assistants may know if one operation is getting ahead of the others in production. Occasionally it is necessary to curtail the output of one department to maintain an equal balance throughout the plant, and the records assist materially in determining the extent to which production should be altered. A summary for the work of each operation is made up from the information on the cards which accompany the shells in each truck. The summary card shows the number of shells received from the previous operation in each truck, and indicates by number the operator who performed the work on them. The number of good shells, the number of defective shells chargeable to the company, the customer and the operator, and the total number worked are listed in consecutive columns. At the top of the sheet is a recapitulation of the number of forgings in the heat, the number yet to to come, the number worked on the last shift, and the number yet to be worked. The summaries for each of the operations are combined on a progress report which includes information regarding the number of machines required for each operation, the machines actually engaged, and the machines in the erecting shop that will be available for the work if needed. This record of the condition of equipment is complete for each operation, and provides the superintendent with information that assists him in bolstering up the productive capacity of any weak department. The report also contains the records of production. At the bottom of the progress report is a brief statement of the fuse socket situation showing the number finished each day. A complete record of the inspection of shells is also shown. This includes a tabulated statement of the number of shells submitted for inspection of the powder pocket, and for the first and final inspection; the number accepted after each of these inspections, the number rejected and the number condemned. The general condition of the plant in regard to raw material on hand and finished product shipped is indicated at the bottom of the report where the shells shipped during the day, the number shipped to date, those ready to ship, the number shipped during the month, and the forgings, fuse sockets, copper bands and rough forgings on hand, are shown.

In spite of the size of the organization, it is not unwieldy, and the alterations necessitated by varying conditions of operation, do not add confusion to the smooth-running order of the plant.



Making Fuse Sockets

THE fuse socket, an intricately shaped ring that screws into the body of the shell and holds the time fuse, is finished from bar stock and is equipped with a thin metallic disc. A seat for this disc is accurately machined in the socket and a small circular ridge of metal is left intact at the edge of the seat. The socket is then placed in a small stamping press and the disc is inserted. The upper die of the machine presses the thin ridge of metal over the disc, firmly holding it in place. Before this method was inaugurated, the crimping was accomplished by small rollers which turned a ridge of metal over the disc.



The Banding Press

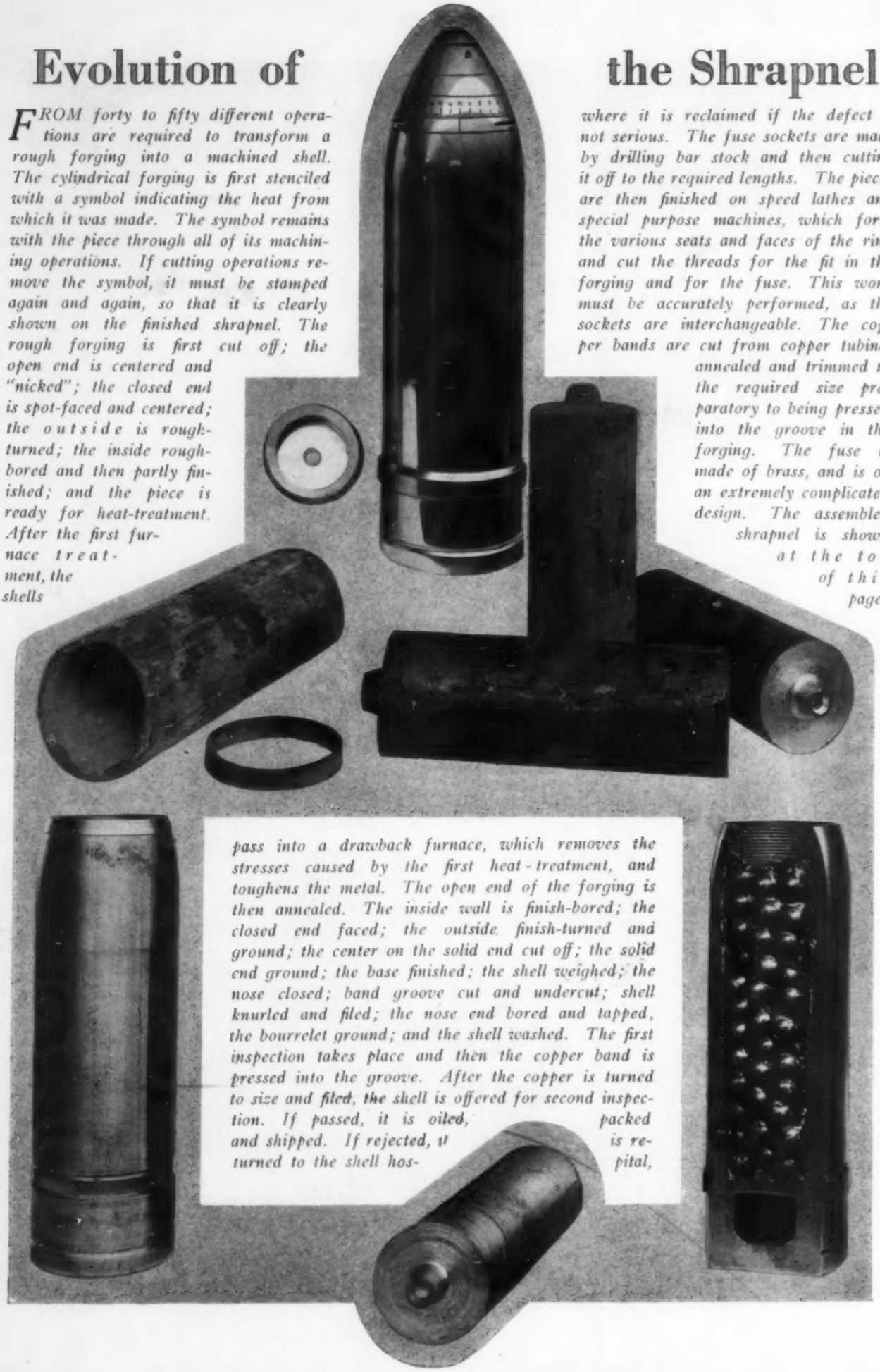
SHRAPNEL shells whirl as they leave the muzzle of a gun. The whirling motion is imparted by the rifling of the gun barrel, which bites into a copper band on the shell. The band is pressed into a dovetail-shaped groove in the shell by means of a banding press. The shell is then placed in a lathe where the copper is machined to size and the burrs filed off. An expanding mandrel has to be placed inside the shell during the banding process to protect the thin wall of the forging where the groove has been cut. Pressure is brought to bear against the copper ring by means of six plungers as shown in illustration.

The Beginning and End

THE operations portrayed on the foregoing pages represent only a few of the steps in the evolution of a shell. From the time the rough forgings arrive at the plant until the inspectors of the Russian commission place their stamp of approval on the finished product, the undivided effort of an organization of 2,500 men is constantly engaged in the work. The accompanying illustrations, evidence of the Symington company's ability to make shells, really constitute an exhibit of the results of co-operation and efficiency.

The inspection of shells is thorough. Ingenious gages for revealing flaws in the metal, and for detecting incorrect dimensions, of poor machine work, are constantly used by the inspectors at work for the Russian commission.

Evolution of the Shrapnel



FROM forty to fifty different operations are required to transform a rough forging into a machined shell. The cylindrical forging is first stenciled with a symbol indicating the heat from which it was made. The symbol remains with the piece through all of its machining operations. If cutting operations remove the symbol, it must be stamped again and again, so that it is clearly shown on the finished shrapnel. The rough forging is first cut off; the open end is centered and "nicked"; the closed end is spot-faced and centered; the outside is rough-turned; the inside rough-bored and then partly finished; and the piece is ready for heat-treatment. After the first furnace treatment, the shells pass into a drawback furnace, which removes the stresses caused by the first heat-treatment, and toughens the metal. The open end of the forging is then annealed. The inside wall is finish-bored; the closed end faced; the outside finish-turned and ground; the center on the solid end cut off; the solid end ground; the base finished; the shell weighed; the nose closed; band groove cut and undercut; shell knurled and filed; the nose end bored and tapped, the bourrelet ground; and the shell washed. The first inspection takes place and then the copper band is pressed into the groove. After the copper is turned to size and filed, the shell is offered for second inspection. If passed, it is oiled, packed and shipped. If rejected, it is returned to the shell hospital, where it is reclaimed if the defect is not serious. The fuse sockets are made by drilling bar stock and then cutting it off to the required lengths. The pieces are then finished on speed lathes and special purpose machines, which form the various seats and faces of the ring and cut the threads for the fit in the forging and for the fuse. This work must be accurately performed, as the sockets are interchangeable. The copper bands are cut from copper tubing, annealed and trimmed to the required size preparatory to being pressed into the groove in the forging. The fuse is made of brass, and is of an extremely complicated design. The assembled shrapnel is shown at the top of this page.

Making Alloy Steels on Big Scale

The Importance of Alloy Steels has been Increasing Steadily in Recent Years, Their Best Market being the Automobile Industry—Quantity-Production Methods are being Successfully Employed by Alloy-Steel Makers

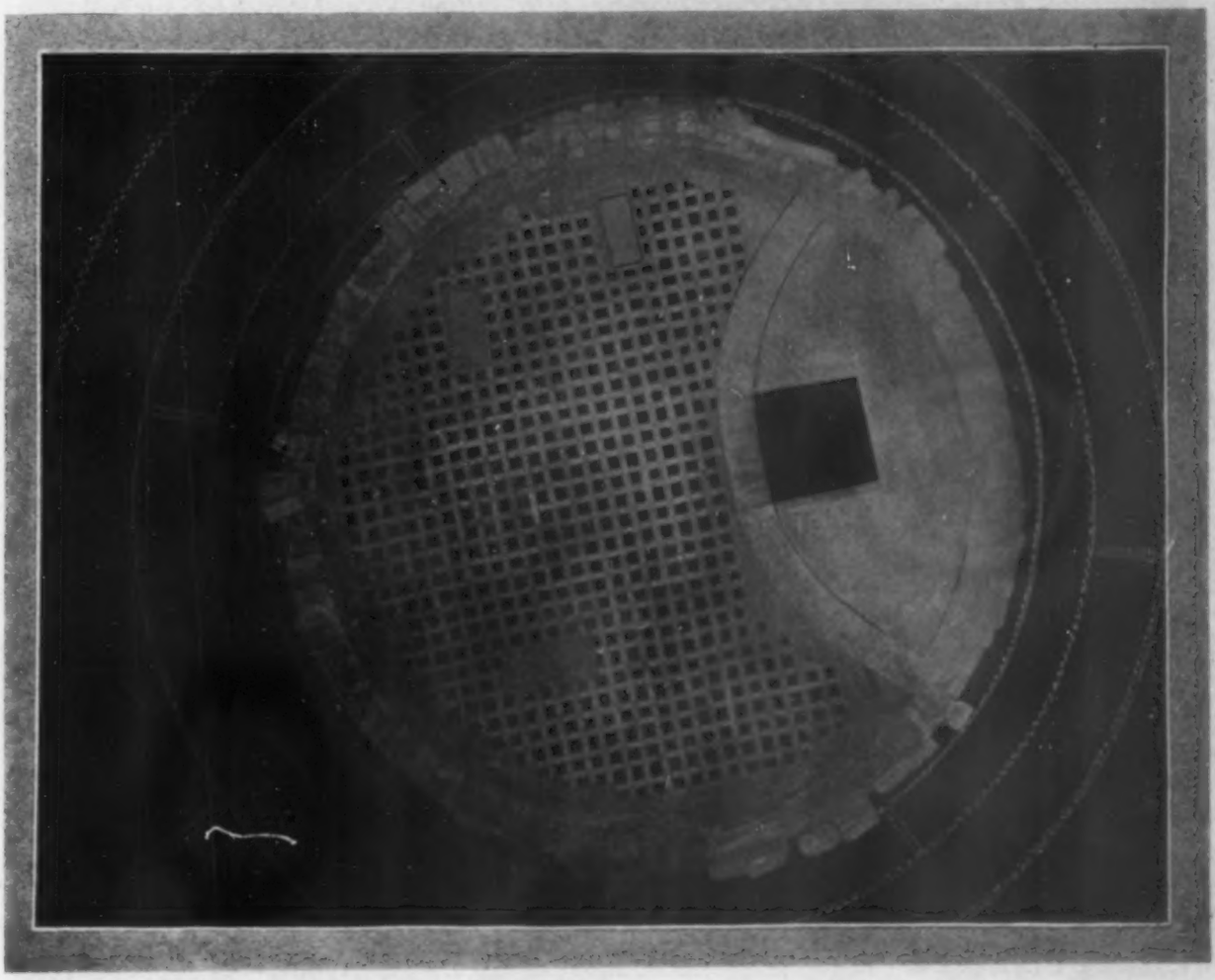
IN AUGUST, 1904, the United Steel Co. began business at Canton, O., with two small open hearth furnaces. In October, 1916, the company was sold to the United Alloy Steel Corporation for $16,000,000. The steelmaking capacity had grown to 18 large stationary open hearth furnaces, one tilting open hearth, and two electric furnaces. The company's growth, while rapid, owes its magnitude largely to a factor which only infrequently explains the expansion of a successful steel company. This factor is the development of a new product.

Exactly three years after pouring its first steel, the United company made a successful venture in the melting of alloy steel on a big, commercial scale. Chrome-vanadium steel was melted in an open hearth furnace and the future course of the company's progress was definitely fixed. Its activities in the manufacture of alloy steels have broadened steadily since that time, although the commercial production of ordinary steel products has been maintained.

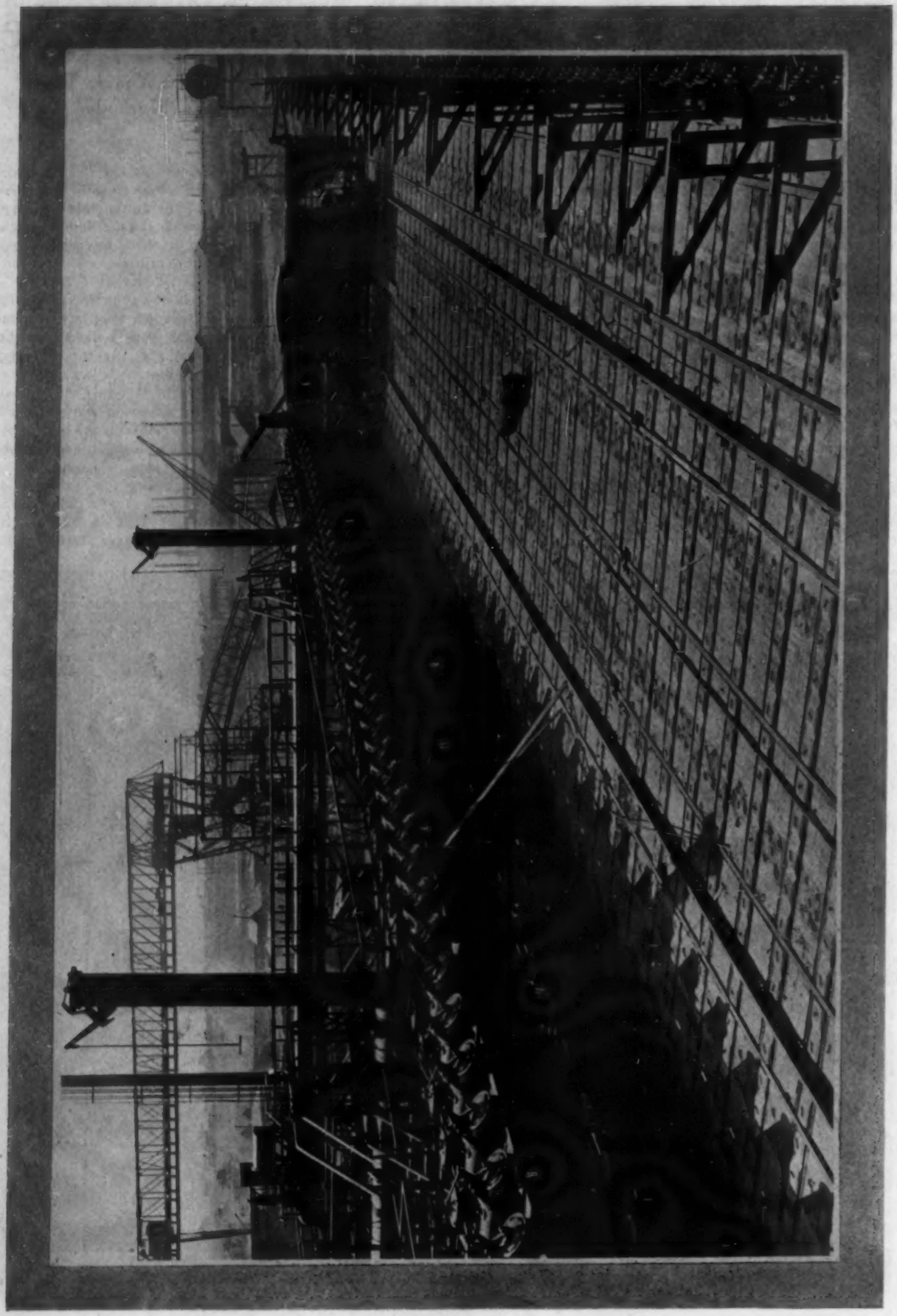
Automobiles and Alloy Steels

Alloy steels were, of course, made commercially before 1907, but their real development began with the introduction, about that time, of large-scale production methods in the automobile industry. The upturn in the production of alloy steels was concurrent with that of automobiles. While the automobile is directly responsible for the growth of the alloy-steel industry, it is equally true that the development of alloy steels largely explains the phenomenally successful growth of the automobile industry. A close parallel can be found a few decades ago in the contemporaneous growth of the railroad and steel industries.

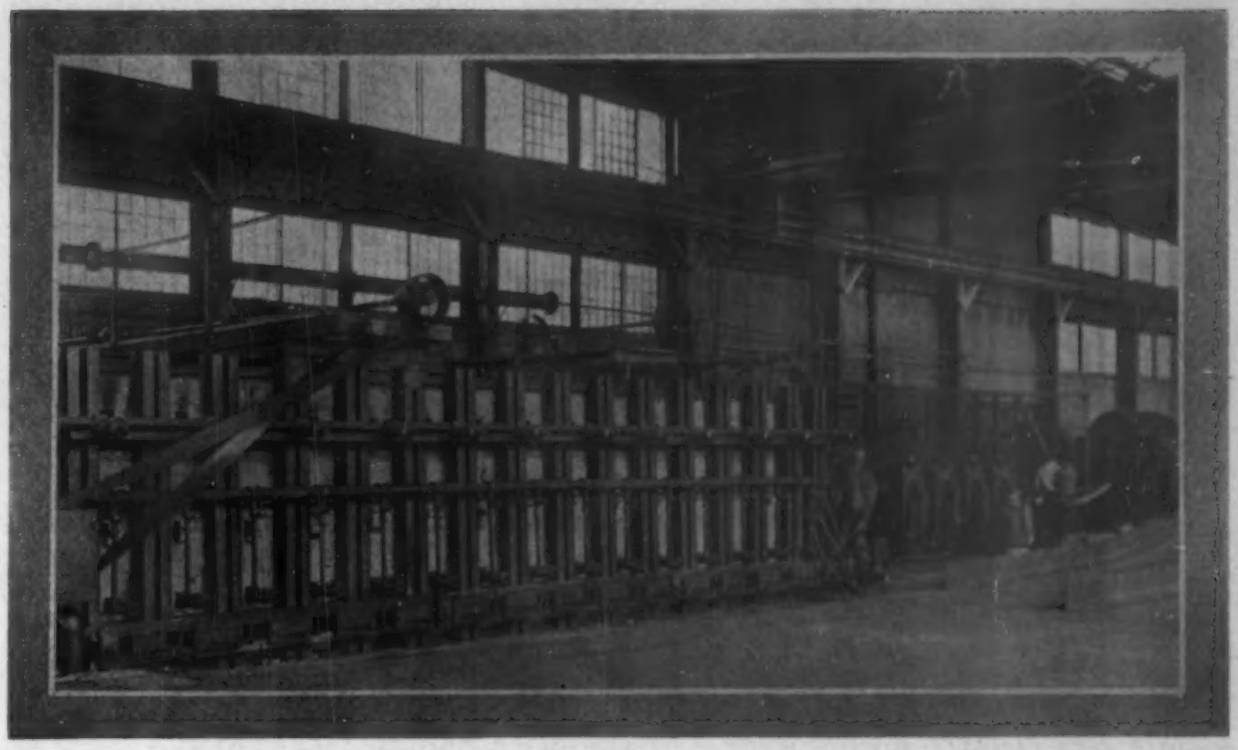
Alloy steels owe their successful development to their property of combining strength with reduced weight. This property is of the greatest value in the automobile which represents the highest type of moving vehicle, either drawn or self-propelled, and which has more moving or frictional parts than a railroad locomotive. The locomotive runs on a smooth track under the guidance of skilled mechanics. The automobile encounters every kind of road and its drivers, generally, have little or no



AN UNUSUAL VIEW SHOWING THE INTERIOR OF A HOT STOVE



TOP OF COKE OVENS SHOWING CHARGING MACHINE—ORE BRIDGE IN BACKGROUND

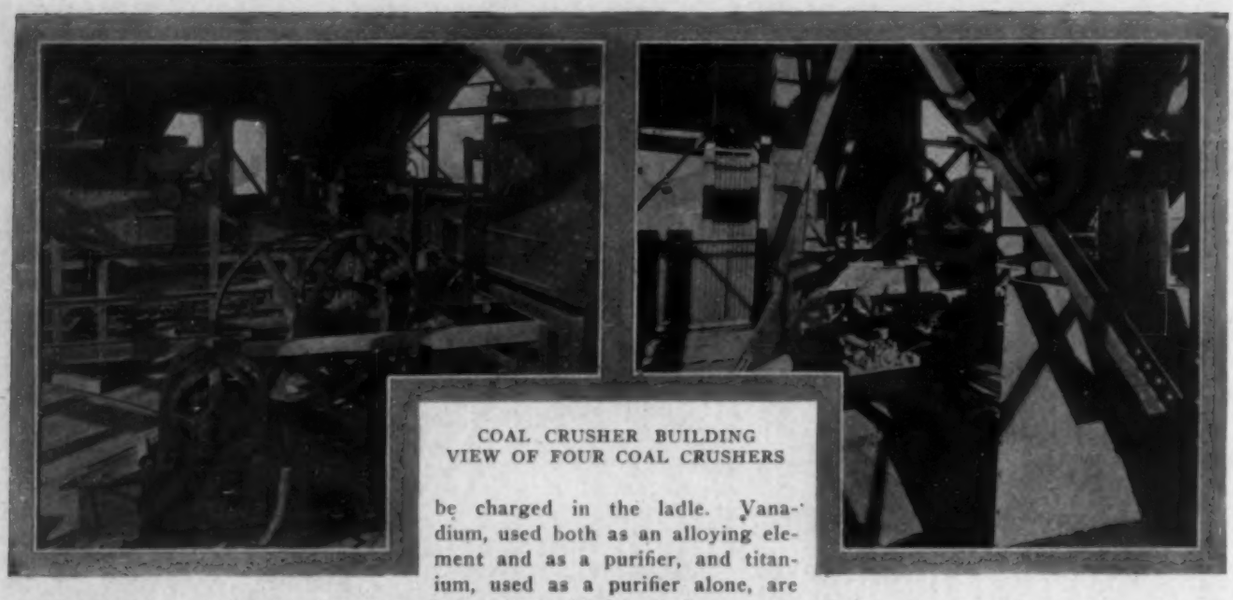


HEATING FURNACE FOR 18-INCH CONTINUOUS MILL

mechanical ability. Under these circumstances the quality of the automobile depends entirely upon the quality of the raw material and the skill and experience with which it is designed and manufactured.

The automobile's successor, the aeroplane, depends to at least an equal, and probably to a greater, degree upon strong but light raw material, and the alloy steel manufacturer is finding an expanding market for his products in this new industry. Not content with these successful invasions into the newer fields of transportation, the alloy-steel producer is giving serious consideration to other problems including railroading. The growth in the length and weight of trains has given importance to a consideration of reducing

COOLING TABLE FOR 18-INCH CONTINUOUS MILL



COAL CRUSHER BUILDING
VIEW OF FOUR COAL CRUSHERS

this weight and in this effort there is much to be expected from a general adoption of alloy steels.

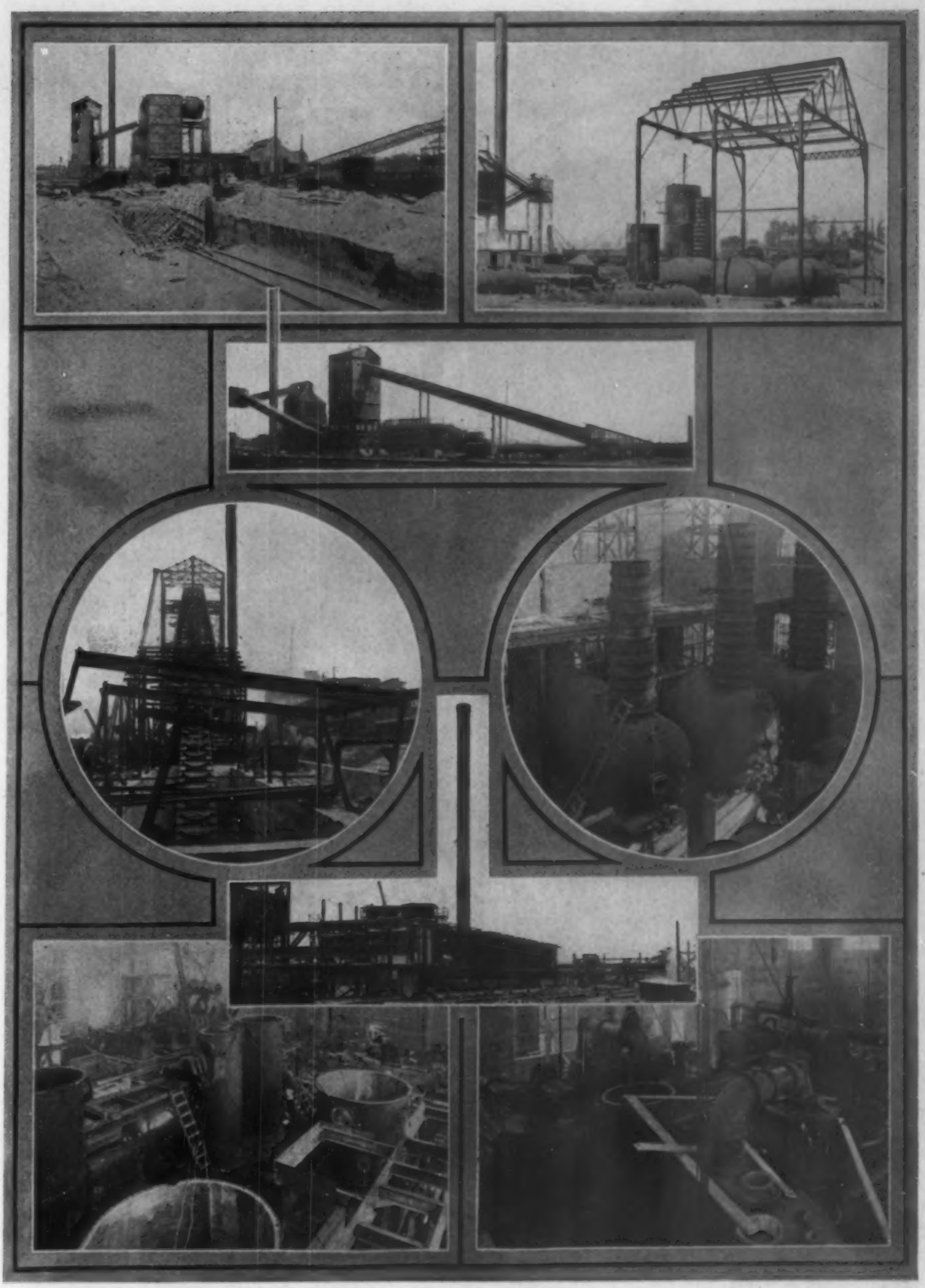
The successful melting of alloy steels in open hearth furnaces requires the solution of problems not encountered in the production of soft steel. At the original plant these problems have been studied for years. Particular emphasis is first laid upon the selection of the raw materials. During the melting of the charge, thoroughness is the main consideration and alloy-steel heats remain in the furnace from two to three hours longer than in general practice. A scientific study has been made of the precise time to add the various alloying elements, and from experience, correct time intervals have been established between additions and before tapping which insure the retention of the full properties of the alloys. Most of these alloys are charged in the furnace, but some must necessarily be charged in the ladle. Vanadium, used both as an alloying element and as a purifier, and titanium, used as a purifier alone, are always charged in the ladle.

The alloy steels containing chromium, especially in the higher percentages, are difficult to melt satisfactorily and unless the melting conditions are correct, unusual trouble will arise in rolling the material. Likewise in heats where nickel additions are made in the furnace only an exacting supervision of furnace operation will give a product which will be free from scabs and seams.

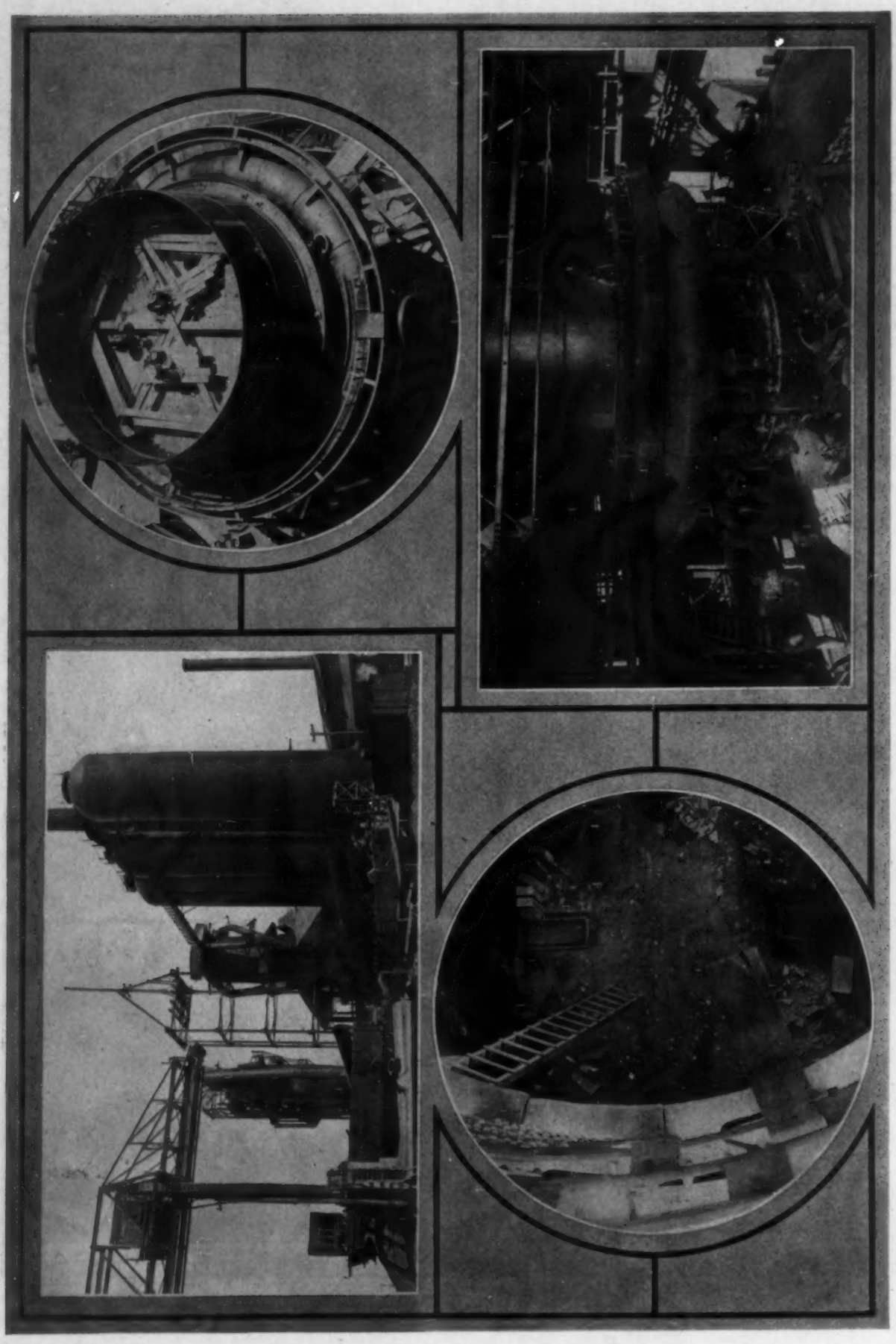
The United Steel Co. was one of the first to embark upon the manufacture of these steels. Its original plant "A" had grown to include 11 steel furnaces, a blooming mill, four bar mills and one rod mill with auxiliary departments, when early in 1916 construction was started on a new steel plant "B" that will include 10 large open hearth furnaces, a blooming mill and a continuous sheet bar and billet mill. At about the same time arrangements were perfected with the United Furnace Co., half of which is owned by the United Steel Co., for the erection of a blast furnace, supplemented by by-product coke and benzol plants. These new construction plans have been almost completed, and have given the company a unified plant.

The growth of the company since its organization in 1904 as the United Steel Co. has been consistent and rapid. The original plan of turning

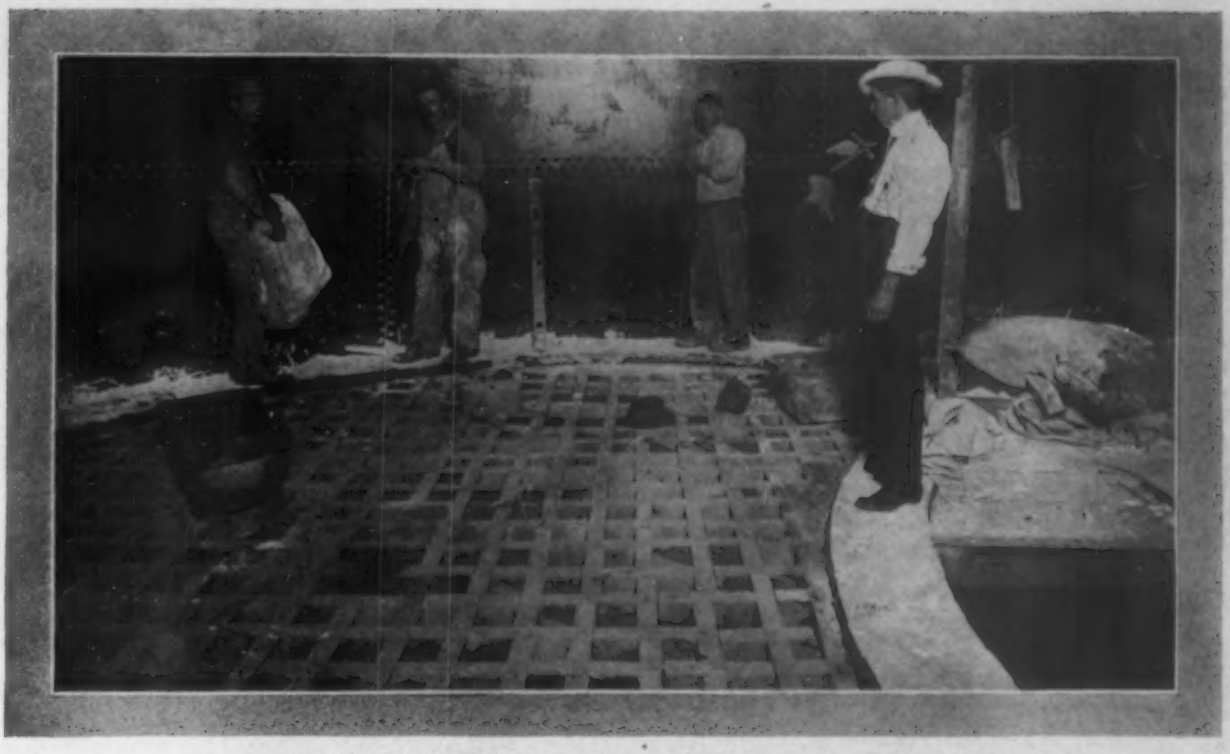
GRINDING SURFACE DEFECTS—DRILL-TEST CHIPS—CHEMICAL LABORATORY



BY-PRODUCT COKE OVENS, COAL HANDLING EQUIPMENT AND BENZOL PLANT UNDER CONSTRUCTION



INTERIOR AND EXTERIOR VIEW OF BLAST FURNACE UNDER CONSTRUCTION



UNUSUAL VIEW TAKEN ABOUT HALF WAY UP A HOT STOVE

out plain low-carbon steel was soon broadened, as outlined previously, to include also the manufacture of alloy steels. The rapid extension of the uses of alloy steels, particularly in the manufacture of automobiles, found the company in an excellent position to meet this demand. The company's growth has thus closely paralleled the development of the comparatively recent demand for alloy steels.

The first steel made at the United plant was melted in two 35-ton open hearth furnaces. A third furnace of the same size was added shortly. At that time the finishing capacity comprised a 34-inch universal mill for rolling plates by cross-rolling sheet bars. This cross-rolling process is patented. It has been used successfully by the company since its organization. A full description of the process will be given later in this article. In August, 1907, the company made chrome-vanadium steel in its open hearth furnaces, the first time that this alloy had been made on a large scale in an open hearth plant. Prior to that time the crucible process was employed almost exclusively for making such steels.

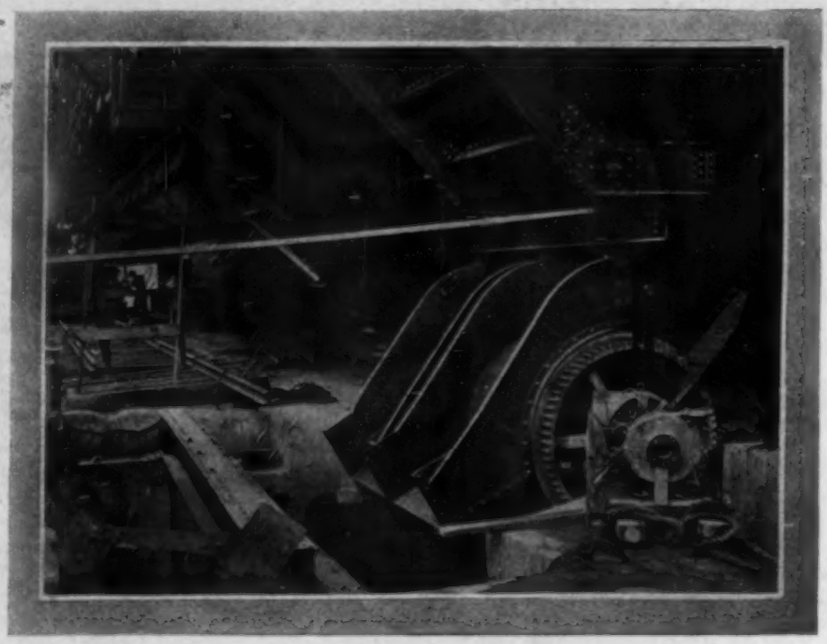
A program of expansion was begun in 1909 that has been carried on almost unbrokenly up to the present time. In July of that year, the company contracted for the construction of two 65-ton open hearth furnaces and they were completed in 1910. The three small furnaces were then torn down and replaced by three 60-ton furnaces, making a total of five large furnaces. Two years later, in 1912, the company installed a 10-inch and a 20-inch bar mill. The 10-inch mill was equipped with 14-inch roughing rolls for breaking down billets. This gave the company its first complete unit for rolling its own steel. Previously the billets for the company's own use had been broken down at an outside plant, but the growth of the alloy-steel bar business demanded an enlarged and unified plant. In 1913, two 75-ton open hearth furnaces were added, a new mill building being constructed. In

ARRANGEMENT OF BINS IN STOCKHOUSE

the same year other extensive improvements were carried through. A new blooming mill engine was furnished by Mackintosh, Hemphill & Co., Pittsburgh. A small heat treating and cold drawing plant, built a year earlier, was replaced by two larger buildings, the heat treating and cold drawing departments being separated.

Country's First Lamberton Mill

The finishing capacity was further increased a year later by the addition of a 9-inch bar mill with a 12-inch roughing mill. In 1915 an 8-inch Morgan continuous mill was begun and it was completed in 1916. At the same time a Lamberton turnover 26-inch billet mill was placed in operation, the first of its kind to be installed in this country. In January, 1915, the old blooming mill, with its tables and manipulators, was torn out and a new 34-inch universal reversing mill was installed by Mackintosh, Hemphill & Co. This installation included a complete complement of auxiliary equipment, such as approach, transfer and runout tables, shears, etc. Early in the same year, the new blooming mill building which had been begun in the fall of 1914 was completed.



BINS IN STOCKHOUSE WITH SKIP PIT IN FOREGROUND

In May, 1915, the eighth stationary open hearth furnace was started. This furnace has a rated capacity of 75 tons and was completed in October.

The company in the meantime had been extending its activities and had installed two electric steelmaking units. A 6-ton heroult electric furnace was begun in 1914 and a 15-ton unit, of the same design, in the fall of 1915. Following the installation of this furnace, work was begun on a 35-ton tilting open hearth furnace, which was completed early in 1916.

The complete steelmaking and finishing capacity in the original plant thus comprises eight stationary open hearth furnaces, three of 60 tons, two of 65 tons and three of 75 tons capacity; one 35-ton tilting open hearth furnace; one 6-ton and one 15-ton electric furnace; one 34-inch blooming mill; one 26-inch Lamberton billet mill; one 10-inch, 5-stand bar mill with a 14-inch rougher; one 20-inch, 5-stand bar mill; one 9-inch bar mill with a 14-inch rougher, and one 8-inch Morgan continuous mill with six 12-inch stands, four 10-inch stands and six 8-inch stands.

The auxiliary equipment has also been replaced or modernized steadily during recent years. The boilers first installed have been rebuilt, the complete boiler house now containing 12 hand-fired Stirling boilers of 250 horsepower each. The original installation of 12 Bradley hand-poked gas producers has been supplemented by 10 hand-poked producers furnished by the S. R. Smythe Co., Pittsburgh. The brick flues, which had originally been built in the ground, were replaced by overhead brick-lined steel flues. The two original soaking pits have been supplemented by two additional 4-hole pits, furnished by the Smythe company.

The buildings at the original plant include a blooming mill building, 80 x 440 feet; an open hearth building, 132 x 360 feet, with a 200-foot extension for the soaking pits, tilting and electric furnaces; a plate mill building, 80 x 300 feet; Lamberton mill building, 70 x 440 feet, with stockhouse, 90 x 440 feet; 9-inch, 10-inch and 20-inch mill buildings, 90 x 400 feet each, with one stockhouse 60 x 40 feet, and one 40 x 250 feet; cold drawing building, 140 x 360 feet; heat treating building, 90 x 480 feet; 8-inch mill building, 85 x 680 feet, with stockhouse, 85 x 200 feet; one machine shop, 100 x 300 feet, and one 50 x 160 feet.

The new plant, as outlined earlier in this article, includes open hearth furnaces, finishing mills and auxiliary departments, supplemented by the blast furnace, by-product coke and benzol plants of the United Furnace Co. The blast furnace was first lighted on Nov. 22, 1916. It has a rated capacity of about 450 tons a day. The bulk of the iron produced will go direct to the new plant of the United Alloy Steel Corporation, the hot metal being hauled about 2,500 feet. Pickands, Mather & Co., Cleveland, are joint owners with the steel company of the United Furnace Co. A second blast furnace is planned for construction in the near future. The by-product coke plant consists of 47 Koppers ovens. The daily coke production is about 600 tons. A comprehensive system of coal handling equipment has been built in conjunction with the coke plant, as revealed in the views of the conveying and crushing machinery shown in some of the accompanying illustrations. A plant for recovering coke oven by-products also has been built, construction views of which are also shown in some of the accompanying illustrations. Waste gases from the by-product coke ovens will be utilized in the furnaces of the steel company, while about 5,000 kilowatts of electric power will be generated for use in the steel plant by the waste gases from the blast furnace.

The plans for the new open hearth plant provide for 10 75-ton furnaces. Of these six have already been put in operation and the other four are under construction. The ingot capacity of the new plant will be about 35,000 tons a month, while the original plant has a capacity of 25,000 tons a month. The combined plants will thus be able to turn out more than 650,000 tons of steel annually.

The new open hearth building, which

OPEN-HEARTH FURNACES UNDER CONSTRUCTION, ELECTRIC FURNACE, POWER AND CONTROL UNITS

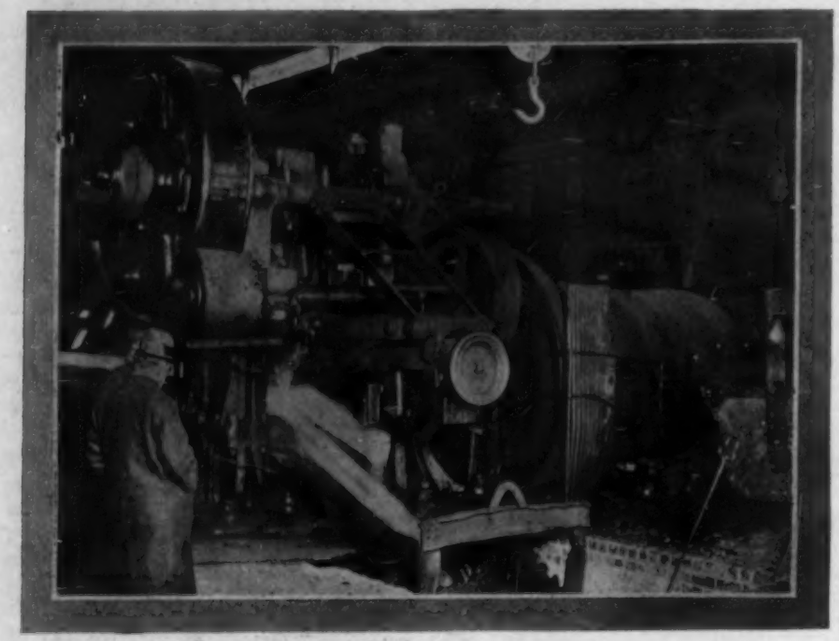
is of steel, is 190 x 920 feet. It follows the lines of modern mill construction and has a monitor-type roof. An 80-foot extension houses the 300-ton hot metal mixer. An enclosed stock building which adjoins the open hearth building is 95 x 600 feet.

The open hearth furnaces in both the new and the original plants follow the designs of the S. R. Smythe Co., Pittsburgh. The furnaces are more strongly constructed than is the general practice. The structural members are unusually heavy while all door sections are specially reinforced. This type of construction was adopted as a precautionary measure to insure continuous and successful operation.

All of the furnaces are built partly below the ground level, the new heating units being 13 feet below ground level and 10 feet above. This underground portion includes 15 inches for a false bottom. In the original plant the furnaces were set even deeper into the ground. This low position of the furnaces permits a much smaller grade on the stock trestle and reduces the height of the building by about 10 feet, thus effecting a considerable saving in the structural steel required.

The one disadvantage in thus locating the furnaces partly below ground level was the danger from water seepage, which, if not checked, would seriously interfere with successful operation. This danger was eliminated by building all the furnaces in pits. These pits have heavy concrete floors and walls and are rendered thoroughly waterproof by asphalt and burlap coverings. A 9-inch brick bottom also is provided which is equipped with a series of flues to carry off any water seepage to nearby sumps. The charging floor is on the ground level, concrete-lined pits being provided on the pouring side.

A 920-foot double-track stock trestle parallels the new open hearth building. The bins in this trestle are of the bottom-dump type. These bins feed directly to charging cars on a depressed track. Special attention was paid to the arrangement of the tracks and the design adopted provides three ways for carrying stock to each battery of two furnaces, thus minimizing the danger of delays in charging any furnace. Cross-overs are provided from the trestle for handling scrap directly to the track on the charging floor. These cross-overs are built between each battery of two furnaces. Approach trestles are also provided at each end of the stock trestle and in the center of the open hearth building, giving the three methods of approach to the charging door of each furnace. A wide bay and track is provided between each set of two furnaces.



UNUSUALLY HEAVY SHEARS ARE REQUIRED

The new furnaces are provided with 20 Morgan mechanical gas producers. A complete series of coal handling, crushing, conveying and storing units has been built. The producers are housed in a 28 x 920-foot building. Bunkers for direct feeding are built over the producers, additional bunkers being provided for storage purposes. The producers are arranged in batteries of four, each battery serving two furnaces. Between each battery, space has been left for installing two boilers, which will operate on waste heat from the furnaces. Two of the boilers have already been installed. They were furnished by the Babcock & Wilcox Co. and will develop 325 horsepower each. Each producer will gasify 3,000 pounds of coal hourly. The gas is led into the furnace through Schild water-cooled gas valves.

Use Both Gas and Oil

In the original plant, natural gas is used in summer and producer gas in winter. Producer gas is supplied to the five older furnaces of this plant by 10 hand-poked Smythe gas producers, and to the three newer furnaces by five Hughes mechanical gas producers. Following the completion of the new plant, producer gas will be used during both the winter and summer in both the new and original open hearth furnaces. Coke-oven gas will be led through 20-inch cast iron pipes from the by-product coke ovens to the bar heating furnaces and soaking pits. Oil tanks and an oil pumping system also are provided for emergency use. The oil is stored in two 100,000-gallon tanks and is available for instant use in case of interruption to the gas supply. The oil also is used after the ports have been burned out, thus permitting 75 to 80 additional heats before relining.

The soaking pit building at the new plant is 90 x 420 feet. It has a 75-foot crane span with a 15-foot bay at one side. The pits were furnished by the Smythe company. Four 4-hole pits have been installed, provision being made for installing three more pits. All ingots are stripped beside the pits, and are placed in the pits immediately after stripping. This arrangement effects a considerable heat saving.

All of the ladles in the new open hearth department have a capacity of 75 tons. The stationary open hearths in the original plant also pour into 75-ton ladles, while from 6-ton to 30-ton ladles are provided for the electric and tilting open hearth furnaces.

Owing to the wide variety in the sizes of the various alloy-steel ingots cast at the United plant, an unusually large stock of ingot molds is carried. These molds will be housed in a special building constructed near the new plant. This building is 85 x 300 feet in size.

Modern Blooming Mill

The 35-inch blooming mill in the new plant was installed by Mackintosh, Hemphill & Co., Pittsburgh. It is housed in a 95 x 700-foot building, flanked by 36 x 200-foot and 50 x 200-foot motor houses. The mill is driven

by a 12,000-horsepower Westinghouse reversing motor. It is fitted with Kennedy manipulators on both sides. The mill follows the same heavy type of construction which was adopted for the mills in the original plant. It has an unusually wide slabbing pass, being designed to roll and edge a 32-inch slab. The runout tables, transfers and shears were furnished by the United Engineering & Foundry Co., Pittsburgh. The bloom shears will handle blooms 8 x 36 inches in size.

Features of Continuous Mill

The 18-inch continuous mill was furnished by the Morgan Construction Co., Worcester, Mass., and is designed to roll both billets and sheet bars. A double set of stands is provided, one for rolling billets and one for rolling sheet bars. The mill can be shifted over from one product to another and the necessary roll changes made, in 35 minutes. The mill is driven by a 4,200-horsepower, 60-cycle motor. It is equipped with Edwards flying shears, measuring shears, Morgan skew assembly table, hot beds and with piling racks for stacking sheet bars. A 120 x 200-foot yard is provided for storing sheet bars.

An interesting feature in the conversion of ingots into bars at the United plant is the cross-rolling method. In general steel practice, the steel is rolled in one direction from the time the ingot enters the blooming mill until the finished bar is completed. The patentee of the cross-rolling method claimed that in general practice, imperfections were elongated and not eliminated, and pointed out that the steel shows a greater tensile strength in a longitudinal section than in a transverse section.

In cross-rolling practice, the bloom is rolled in a transverse direction to that in which the ingot was rolled. The result is claimed to be a greater uniformity in the metal, as test pieces taken longitudinally and transversely show the same physical results. Interior pipes are said to be brought to the surface where they can be cut out, while surface steams are localized and easily removed.

Billets Receive Thorough Inspection

Particular attention is paid to the removal of these seams and pipes. One method of billet cleaning is shown in one of the accompanying illustrations which shows the grinding room. All surface defects such as seams, snakes, scabs, etc., are eliminated by machine cutting, chipping, grinding or by a combination of these methods, before the billet is rolled into the finished bar. Emphasis is laid upon a thorough inspection of all billets.

In the new open hearth plant three 100-ton double-trolley ladle cranes and one 60-ton double-trolley hot metal crane have been installed. Each crane is equipped with a 25-ton auxiliary hoist. Two 15-ton cranes command the open hearth furnaces themselves, and facilitate repairs. The two charging machines are each of 10 tons capacity. One was furnished by the Morgan Engineering Co., Alliance, O., and one by the Wellman-Seaver-Morgan Co., Cleveland. In the stockhouse are two 15-ton Alliance magnet cranes. The gas producers are served by two 5-ton traveling cranes, each equipped with a 2-yard clam shell bucket. The mold storage building is commanded by a 10-ton crane. In the soaking pit building are a 100-ton stripping crane, a 10-ton pit charging crane, and a 15-ton crane. A 25-ton crane equipped with a 10-ton auxiliary serves the blooming mill building, and a 15-ton crane the bar mill building. One of the two buildings housing the mill motors has a 50-ton crane and the other a 30-ton crane. The sheet bar stockyard is commanded by a 15-ton crane. The main stock yard has a 15-ton crane and two skull breakers. Most of the crane equipment in the new plant was furnished by the Alliance Machine Co., and the rest by the Morgan Engineering Co., both of Alliance, O.

ONE OF THE HAND BAR MILLS IN THE ORIGINAL PLANT

At the original plant the open hearth ingots are broken down in the blooming mill to a 6 x 8-inch bloom, although a 1 x 8-inch slab can be rolled on this mill. Some electric steel ingots also are broken down on this mill but the standard practice is to handle electric ingots in drop hammers for forgings and in a hydraulic press for squaring and reducing to billets. This practice thus includes forging, pressing and rolling and gives an unusually homogeneous steel. The drop hammer equipment comprises a 3,000-pound Bell hammer and a 1,500-pound Lane hammer. The hydraulic press has a capacity of 500 tons and was furnished by the United Engineering & Foundry Co. This press is controled by only one lever.

Alloy steel, owing to its hardness, requires rolling mills of heavier construction than those used in breaking down ordinary low-carbon steel. The strains put on these mills are never encountered in the usual rolling mill. The United blooming mill, which was specially designed and built, is equipped throughout with cut gears. The side bevel gears are extra heavy. They are completely enclosed and run in oil. The driving pinion is a nickel-steel forging and has helical teeth. The other pinions are nickel-steel castings. The crown and sleeve gears are manganese steel.

Even with the specially designed mill, a draft of more than ½-inch is never taken on the blooming mill, while the usual reduction in each pass is from ¼ to ⅜-inch. The breaking-down process cannot be crowded more rapidly without great danger of damage to the mill.

All tables connected with the blooming mill, as well as with all of the other mills, are magnetically controled. The control apparatus was furnished by the Electric Controller & Mfg. Co.,

Cleveland, and the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

The 26-inch Lamberton or Scotch billet mill differs radically from the usual types of rolling mill. The entire mill reverses between passes thus combining the economies of a continuous drive with the advantages of a stationary table. As the housing makes a half turn, the relative position of the two rolls is changed. The mill is reversed in from four to six seconds.

The reversal is accomplished through a rack and tooth pinion, actuated by hydraulic cylinders. The mill is fitted with the same type of table and gears as the other mills and was also furnished by Mackintosh, Hemphill & Co. It is driven by Westinghouse motors, functioning through reducing gears and a flywheel. All of the rod mills as well as the Lamberton mill are electrically driven, the plate mill alone being steam driven.

All blooms intended for conversion into bars are turned to the same side after leaving the blooming mill, the slabs go in a straight line to the shears, while the sheet bars intended for conversion into sheets, are turned to the other side.

The shearing equipment for handling blooms comprises three hot shears, each 30 inches wide. A 42-inch slab shear is provided for handling stock up to 3 inches thick. There is also a 48-inch sheet bar shear and a 108-inch plate shear which can handle cold stock up to 1 inch thick. A rotary slitting shear is provided which will cut stock up to ¾-inch thick.

The Lamberton mill is served by a horizontal bloom shear which will cut stock up to 8 x 10 inches in size. A billet shear also is provided with this mill which will cut four 4 x 4-inch billets at one time. The other mills are equipped with the usual bar shears. A spring shear for cutting automobile-spring stock also is provided.

Using Waste Heat

The continuous heating furnaces which are employed to heat the billets after they leave the blooming mill are equipped with a regenerative feature designed by the company's own engineers. The cold air is blown through 30 8-inch double extra heavy wrought iron pipes. These pipes are 14 feet long. The pipes extend through a baffle plate at the top of the furnace. The waste gas is led around these pipes, thus preheating the incoming air. The capacity of these pipes exceeds that of the fan, thus checking the rush of the air as it passes into the flues. This regenerative feature, which is patented, thus gives a maximum amount of preheating. The 9-inch, 10-inch and 20-inch bar mills are served by four furnaces, each 52 feet long and 12 feet wide. The 8-inch mill is served by a Morgan patented continuous furnace, 25 x 35 feet in size. This furnace is designed to accommodate a 30-foot billet. All furnaces are gas fired, but are designed to permit the use of coal in an emergency. Natural gas is now being used but present plans call for the use of coke-oven gas. The furnace equipment also includes two forging furnaces of the company's own design. These units are 10 x 12 feet in size.

Handling the Bar Stock

Automatic coiling reels are used to handle the bar stock as it leaves the 8-inch continuous mill. The smallest bundles coiled on these reels have an inside diameter of 16 inches, the largest bundles having an inside diameter of 34 inches. The bundles vary in weight, the heaviest weighing 300 pounds. The heaviest stock coiled is ⅝-inch thick. The bundles are transferred direct from the rolling mill department to the cold drawing department.

The bar on leaving the rolls is led through a movable pipe which directs the bar to the reels. These reels, of course, operate at the same speed as the mill thus preventing any possibility of buckling. When the bundles are completed, the bar is sheared, the movable pipe swings about and diverts the bar to another reel, and the completed bundle is dumped by a steam cylinder onto a conveyor. These operations are controled by one pulpit boy through a simple set of levers.

The crane equipment of the original plant is unusually complete, and in all departments particular attention has been paid to arrangements for handling the products quickly. Most of these cranes were furnished by the Morgan Engineering Co. and the rest, with one exception, by the Alliance Machine Co. In the open hearth department there are three 75-ton ladle cranes with 25-ton auxiliary hoists, a 35-ton ladle crane for the tilting and electric furnaces, two 100-ton strippers, one low-type pit crane which can handle a 7½-ton ingot, two 10-ton traveling cranes with hand tongs for serving the soaking pits, two Wellman-Seaver-Morgan and one Morgan low-type charging machines, and one 15-ton crane over the open hearths for cleaning and repair work.

The blooming mill is commanded by two 20-ton and one 15-ton crane. The plate mill is served by two 10-ton cranes. The Lamberton mill has one 40-ton and one 15-ton crane, the stockhouse for this mill being equipped with three 15-ton cranes. There are six 10-ton cranes serving the 9-inch, 10-inch and 20-inch mills, the stockhouses for these mills having four 15-ton cranes. The stockhouse of the 8-inch mill has three 10-ton cranes. In the heat-treating plant is one 10-ton crane while the cold-drawing department has two 10-ton cranes. There is one 15-ton crane in the machine shop, cranes of equal capacity being installed in the locomotive repair and roll shops. The stockyard is commanded by four 10-ton magnet cranes. A 30-ton crane is installed over the blooming mill engine for handling repair work.

The heat-treating and cold-drawing operations now carried on in the original plant will shortly be concentrated in two separate buildings at the new plant. The new heat-treating building will be 95 x 480 feet while the cold-drawing building will be 160 x 340 feet. At the new plant, it is planned to automatically handle and heat treat 25-foot bars. The material will advance progressively through a first furnace for heating to the quenching temperature; by conveyors through the quenching tanks into a second furnace for heating to a drawing temperature; thence to straightening tables. Special furnaces will be installed for pipe and pot annealing and for annealing coils.

Many Kinds of Steel Made

The United company manufactures a complete line of electric and open hearth alloy steels. These alloys include chrome-vanadium, chrome-nickel, plain nickel steel (up to 5 per cent nickel), chrome-carbon, tungsten steel for magnets, and chrome-silico-manganese steel. These products are turned out in the form of blooms, billets, slabs or bars, the bars being rolled into rounds, squares or flats in sizes from 3/16-inch to 5½ inches. Universal plates also are rolled, ranging in size from ¼ x 12 inches and heavier up to ⅜ x 46 inches and heavier. The company's products are used principally in automobiles, heavy-edged tools, magnets, ball and roller bearings, heavy-duty machinery, railroad cars and locomotives, and aeroplanes.

Harry R. Jones, formerly vice president, treasurer and general manager of the United Steel Co., is president of the United Alloy Steel Corporation. Associated with him in the management are Edward Langenbach, E. L. Mang, E. D. Rogers and John McConnell.

Confidence Pervades Ore Districts

Iron Ore Operators in the Lake Superior Fields Are Positive of Their Ability to Supply 1917-18 Furnace Demands—Labor Conditions Uncertain—Review of 1916 Developments

BY R. V. SAWHILL

THE Lake Superior mine operator is facing 1917 with the calm confidence of a Joffre or a Von Hindenburg. He has just completed a season in which he surpassed all his previous ore-shipping efforts by seventeen millions of tons, or 33 per cent. His 1916 success was a continuous surprise, partly to himself but mostly to those next in line in the ore-to-iron chain—the carriers, agents and consumers. Flushed by his recent triumph and encouraged by a record price for his goods, the man on the ground in the Lake Superior fields has confidence, born of past success and a promising future, in his ability to ship all the ore that may be needed in 1917.

This feeling of assurance is infectious. An observer, fresh from the lower lake districts where the stream of confidence rises and ebbs with almost tide-like persistence, is innoculated as soon as he reaches the ranges. It requires almost a physical effort to keep one's feet on solid ground and one's head above the stream, and recall that some other link in the chain between the mine and the blast furnace, may part under the strain of another year of maximum effort. The confidence of the ore miners is reassuring, but due consideration must be given to the docks, the freight carrying fleet, and the railroads, before the observer sees his confidence deepen into a conviction that enough ore will be placed in furnace yards during the next 12 months to meet the demands of a clamorous buying public.

Any serious shortage of ore, therefore, if such should develop during the next year, is likely to result from the inability of the transportation end of the business to fulfill the demands upon it. The ore carrying railroads of the north have adequate facilities for handling another maximum movement. The docks can load the vessels, while the performance of the railroads in removing ore from lower lake docks during the past season lends plausibility to the belief that they can duplicate their work this year. The crux of the situation seems to lie, as it did last year, in the capacity of the lake fleet to move the ore.

A year ago, to the same degree, the mining organizations felt confident of

Table I

Approximate Shipments by Ranges

	Gross Tons. 1916	1915
*Mesabi	41,862,579	29,756,689
*Vermillion	1,802,133	1,733,595
*Cuyuna	1,696,076	1,136,113
Total Minnesota	45,560,788	32,626,397
*Gogebic	8,137,879	5,477,767
*Marquette	4,933,414	4,105,378
*Menominee	6,311,340	4,982,626
Mayville, etc.	142,500	80,583
Miscl. shipments by rail	1,750,000	†
Totals	66,635,921	47,272,751

*Includes lake shipments only in 1916.
†Absorbed in range figures for 1915.

THAWING OUT IRON ORE IN D. M. & N. YARDS AT PROCTOR

their ability to ship forward all the ore wanted. Some uneasiness was felt at that time over the ability of the fleet to handle the ore, but this fear proved groundless. As late as the middle of the past summer, predictions were freely made in many quarters that the lake fleet could not move more than 55,000,000 tons, while before the opening of the season, 53,000,000 tons was considered the maximum. That the fleet was able to shatter these fears was due to a number of factors. Primarily the vessel men demonstrated an innate ability to meet an unprecedented situation. But physical conditions were favorable, the water in connecting channels being higher, weather generally favorable, delays and accidents at a minimum, and dispatch at both upper and lower lake ports excellent. The occurrence of unfavorable physical conditions during the coming season would increase the uneasiness again felt over the fleet's ore-carrying capacity, as the new tonnage available is not large.

On Jan. 1, 1917, there were 537 bulk freighters with an aggregate gross tonnage of 3,085,662 available. A year ago there were 542 vessels with an aggregate gross tonnage of 3,059,296. The numerous sales of small carriers to ocean interests account for the decrease in number of vessels while the greater size of the new boats explains the increase in gross tonnage. During 1917, six additional bulk freighters will be launched, having an aggregate gross tonnage of about 66,000. The present capacity of the fleet, as indicated, closely approximates that of a year ago. All of this capacity, of course, is not available for carrying ore continuously. The grain and coal trades make heavy inroads. The coal carrying business in 1917 will probably exceed that of 1916, as the supplies of fuel at the head of the lakes were not fully replenished this year. The lake transportation end of the trade thus is surcharged with the possibilities that were present a year ago—and which failed to materialize.

The one factor in their department which some operators fear may prevent another titanic ore movement in 1917, is some critical development in the labor situation. But most of the mine managers point to 1916, when they kept ore steadily moving forward in the face of a strike that tied up underground properties on the Mesabi and Cuyuna ranges. Labor conditions at this time seem to be steadily improving, but if a strike of the miners develops next summer, its effects have already been largely discounted. Most of the big open pit properties on the Minnesota ranges are practically in shape to duplicate their great 1916 records. Stripping operations are being pushed steadily this winter and some new properties will be in readiness to ship large tonnages.

Pleased With New Ore Prices

Squaring with the feeling of confidence in their ability to forward ore, one finds among the Lake Superior operators a deep rooted satisfaction over the new ore prices. The horizontal advance of $1.50 a ton has been the clearest and most tangible evidence the mining companies have seen of the prosperity that has inundated the steel industry for the past year and a half. There was a general feeling throughout the district that the 1916 ore prices were too low in relation to the ballooning ascent of quotations on steel, both in semi-finished and finished forms. The new prices are in some cases the highest on record, and in others the highest in a quarter century, and the mining companies naturally are immensely pleased. They feel that they will now begin to obtain their bit of the war time prosperity.

The advance in ore prices carries old range bessemer ore from $4.45 to $5.95 a ton; old range non-bessemer from $3.70 to $5.20; Mesabi bessemer from $4.20 to $5.70, and Mesabi non-bessemer from $3.55 to $5.05. The advance does not by any means represent a net advance in profit of $1.50 to the mine operator. The freight carrying rate has been increased from 50 cents to $1, net, from the head of the lakes. From Marquette the new rate is 90 cents, net, and from Escanaba, 75 cents. The coal carrying rate has gone up; coal and mining supplies are more expensive and in cases where mine royalties are adjusted on a sliding scale basis, there will be an advance this year. As an illustration of the increase in the prices of mine supplies, mine timbers are now quoted at 5½ cents per lineal foot, compared with 4¼ cents a year ago and 3½ cents in 1915. Three increases have been made in wages during the past year, the final advance

THE D. & I. R. TERMINAL AT TWO HARBORS. NEARLY 11,000,000 TONS OF IRON ORE WERE HANDLED OVER

being a horizontal one of 10 per cent effective Dec. 15. It is reliably estimated that the sum of all the increases, in freight, supplies, royalties and labor, will reach at least 85 cents a ton, or more than half of the increase in ore prices.

Attention was drawn in our review of ore conditions in *The Iron Trade Review*, Jan. 6, 1916, to the only artificial factor in the situation, the purely emergency requisitions from the eastern blast furnaces. The road to the furnaces east of Pittsburgh, opened up by the Underwood tariff act, has been effectually blocked for over two years by the artificial tariff wall imposed by the war. As a result, eastern furnaces have been buying heavily of Lake Superior ores, a condition that will hardly obtain after the traffic lanes on the ocean are reopened. These furnaces in 1916 took about 2,936,000 tons of ore from the lake district, and their 1917 requirements will be fully as heavy. The balance of the tonnage will be taken by the furnaces of the lake and middle western districts to meet an insistent demand, partly due to the war but resulting more and more from a vigorous revival of domestic consumption.

The 1916 *Shipments*

Iron ore shipments for 1916 are estimated at 66,500,000 tons, an increase of 19,225,000 tons over 1915, and of 16,550,000 tons over 1913, the previous record-holding year. The increase last year over the previous year's movement was approximately 41 per cent. The following table, showing the lake movement by months, furnishes an excellent index to the consistently fine showing made by the lake fleet:

GROSS TONS

	1916.	1915.
April	1,658,411	503,832
May	8,449,580	5,012,359
June	9,507,576	6,005,091
July	9,750,157	7,204,021
August	9,850,140	8,081,117
September	9,600,786	7,863,146
October	9,116,196	7,146,873
November	5,715,452	4,445,129
December	1,085,900	57,236
Total	64,734,198	46,318,804

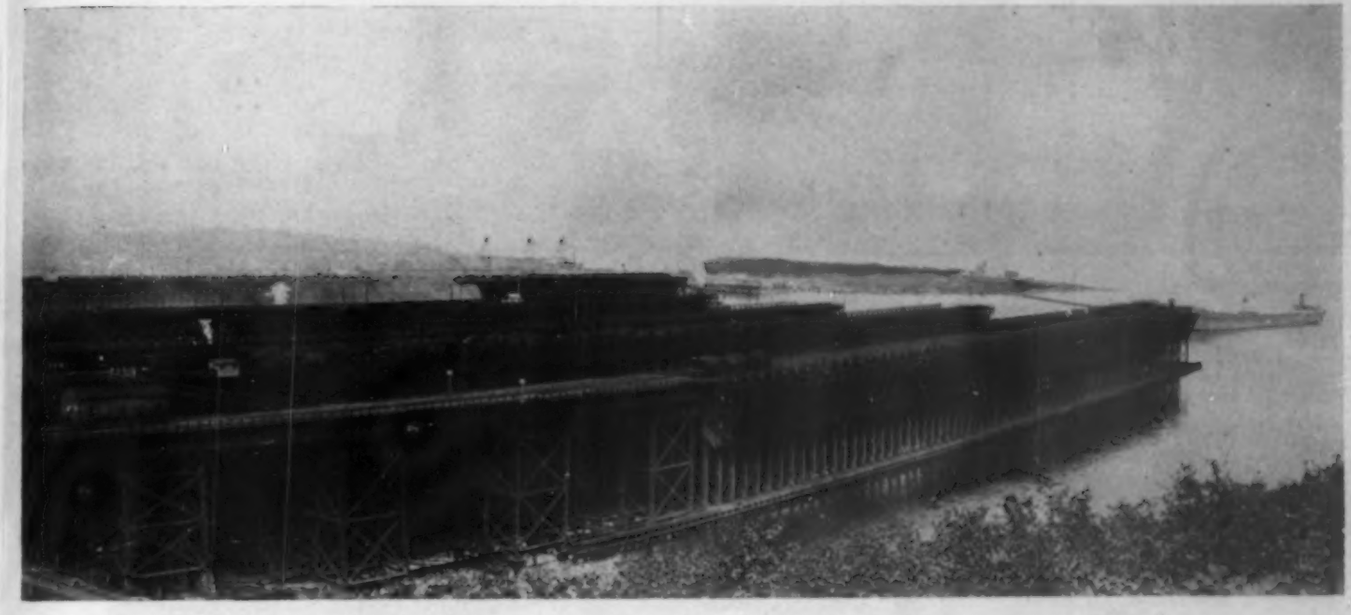
The 1916 lake movement, as the figures indicate, was a record breaking one from the start. The aid of ice breakers was enlisted in April to clear the channels of ice with the result that shipments that month were 1,658,411 tons. May, the first month in which all of the boats were operating, set a new record for shipments in one month, surpassing by 245,000 tons the previous record made in July, 1913. June, July and August, each in turn, set up a new mark, the latter months' movement of 9,850,140 tons now holding the record. The November shipments were another surprise, while the movement of more than 1,000,000 tons in December was far ahead of anything ever attempted in that month.

The Minnesota ranges sent forward practically 70 per cent of the lake movement and a larger share than usual of the all-rail movement. The three Minnesota ranges forwarded a total of 45,360,788 tons by lake, while the three old ranges shipped out 19,381,779 tons. The old ranges, particularly the Gogebic, made surprisingly large shipments. The Gogebic's total was swelled by the shipments from the two open pits recently opened on that range, the Wakefield and the Plymouth.

Rail Shipments Heavy

The all-rail movement for the season probably will be found to have exceeded 1,750,000 tons. The normal all-rail movement has been around 900,000 tons, but in addition to the normal increase this year, the all-rail total is boosted by the shipment of nearly 585,000 tons to the new Minnesota Steel Co.'s plant at Duluth. Some all-rail ore also has been forwarded to St. Louis, while in some instances shipments by railroad were made in December of ore that the fleet was unable to move before the season closed.

The immense movement from the Lake Superior district has, of course, brought the stockpile balance to a low figure, and at most mines practically no ore was being carried in stock on Dec. 1. Operators on the Minnesota ranges, with their large number of open pit properties to draw from, find little or no cause for anxiety in this situation. On the old ranges, with their preponderance of underground mines, more trouble will be experienced in hoisting enough ore this winter to bring the stockpile balance, at the opening of navigation to a figure approximating normal. On these old ranges, two and three shifts are being worked in many cases on development and mining work, and every effort is being made to place these properties in a posi-



THESE DOCKS IN 1916. THE DOCK NOW UNDER CONSTRUCTION IS SHOWN IN THE RIGHT BACKGROUND

tion to duplicate their 1916 performance. The new open pit properties on these ranges had not yet attained their maximum production last year and, assisted by the stripping and development work now under way, will be able to reinforce the underground output.

Oliver Company's Shipments

The total shipments of the Oliver Iron Mining Co., the mining subsidiary of the United States Steel Corporation, aggregated 30,867,671 tons. Its percentage of the total movement was thus 46.42 per cent, compared with 47.63 per cent in 1915, 49.01 in 1914 and 49.06 in 1913. A comparison of these ratios indicates clearly the relatively more rapid growth of the independents during recent years. The Steel Corporation's percentage has declined steadily, with the exception of 1911, since 1908, when its shipments were 56 per cent of the entire movement.

The Duluth, Missabe & Northern railroad carried by far the heaviest tonnage of any of the ore carriers. As shown in Table II, this road handled 21,837,849 tons, while the Great Northern railroad, the nearest competitor, carried 11,091,010 tons, and the Duluth & Iron Range railroad was third with 10,735,853 tons. The D., M. & N. handled nearly 34 per cent of the total movement by lake, a slight gain over its percentage in 1915. The Great Northern railroad, whose shipments had fallen off markedly following the surrender of the Hill lease, made a relative as well as an actual gain last year, handling a little more than 17 per cent against 15.56 per cent in 1915. The Chicago & Northwestern railroad made a relatively large gain in its shipments from Ashland, handling 10.40 per cent of the total lake movement over its docks at that port, compared with 8.93 per cent of the shipments in 1915.

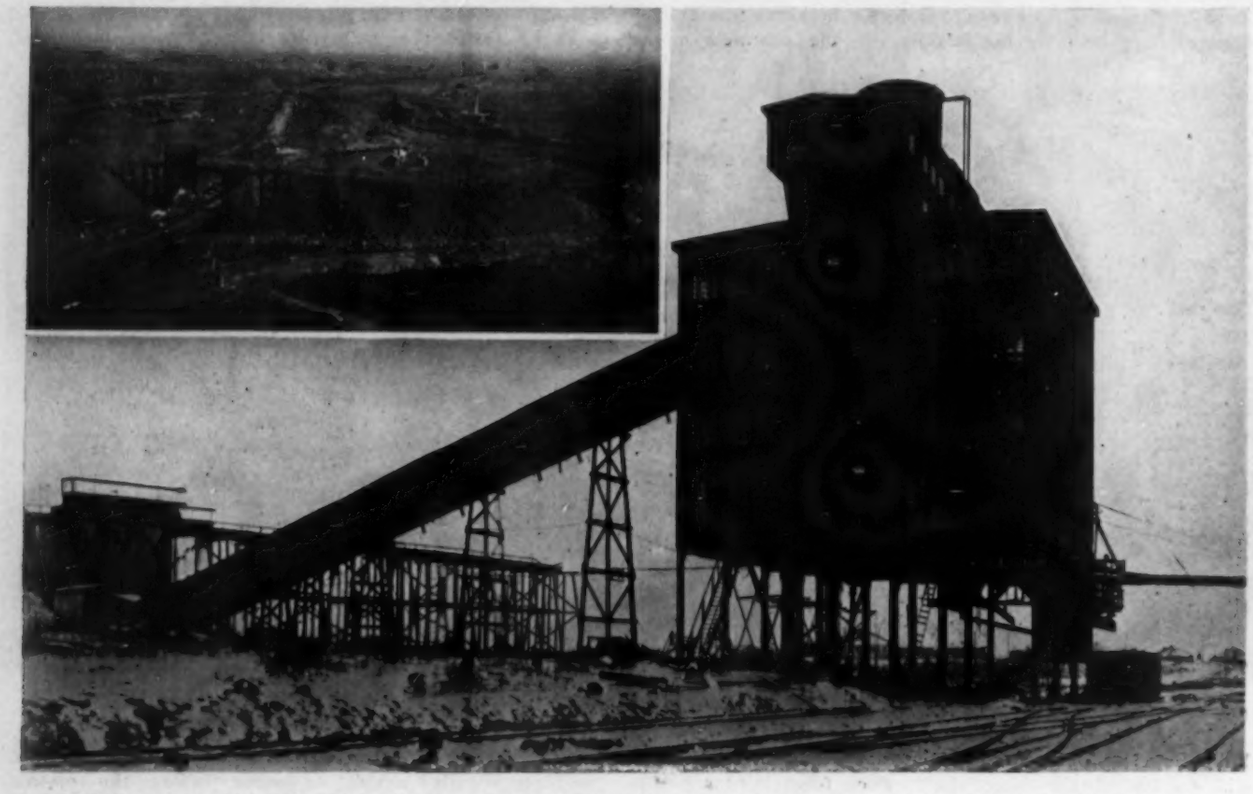
The labor situation on the Minnesota ranges, particularly the Mesabi, is charged with either flashlight or blasting powder. In other words, this year may bring forth plenty of noise and little action, or plenty of both noise and action. The presence on the ranges of a number of agitators insures the noise, while the action depends upon the impression this noise will make upon the miners, who are now earning the highest wages in their history. The impression has been gaining ground steadily during recent weeks that the agitators attained their maximum results when they succeeded in bringing about a strike last summer, and that their influence is steadily waning. Some proof of this is found in the dwindling attendance at recent meetings which have been fostered by these outsiders.

Labor conditions today are by no means clearly defined. One operator, not personally located in the mining districts, voiced the sentiment that the situation was a "seething mass". Another operator, who lives on the Mesabi, finds plenty of encouragement in the miners' present attitude.

Wage Increases Block Agitators

The large and generous wage increases have had an appreciable effect in smothering the spread of the incendiary influence of the agitators, while the dissatisfaction with last summer's futile strike is proving a bar to further success in promoting action along the same lines.

The strike last summer crippled some mining companies but did not diminish shipments. The trouble affected only the underground properties on the Mesabi and Cuyuna, merely forcing the big open pits to speed up their shipments, which they were abundantly able to do. What was probably the most serious permanent result of the strike was the departure of many of the better and more industrious miners to other districts, notably to the copper mines of Michigan and Arizona. Following the tremendous outflow of common labor during the depression of 1914, many of whom did not return during



WASHING AND CONCENTRATING PLANTS OF THIS TYPE NOW HANDLE MUCH OF THE WESTERN MESABI ORE. INSET SHOWS SEPARATOR AT SUSQUEHANNA MINE

the prosperous seasons of 1915 and 1916, this additional loss was seriously felt.

It is common gossip along the Mesabi that the Oliver Iron Mining Co., owing to its size and importance, was the principal target at which the strike was aimed. The results, both in this respect and in the lack of success of the strike itself, were disappointing to the agitators. The owners who suffered most from the strike were various independent operators, particularly those with only a few underground properties. The bigger operators merely rushed their open pit properties and, outside of greater care necessary in grading ore, had little trouble in sending forward shipments in the quantity and of the quality desired. Some of the independents with few properties were unable to grade their ore, and were forced to send forward ore of a different grade than their contracts specified.

Numerous Wage Increases

Common labor on the Mesabi on Dec. 1 was being paid $2.60 a day. The third increase of the year, announced in November by the Oliver company and universally followed by all operators, took effect on Dec. 15. This raise was a horizontal increase of 10 per cent. Common labor for the past three weeks has thus been paid $2.86 a day. Miners working on company account were drawing $2.90 to $3 a day, and since Dec. 15 have been paid $3.20 to $3.30 a day. Contract miners were averaging $3.50 a day and are now averaging $3.85 a day. The increases in wages during the past 12 months were:

	——Daily Wage——		
	Dec. 1, 1915.	Dec. 1, 1916.	Dec. 15, 1916.
Common labor..	$2.25	$2.60	$2.86
Miners (co. act.)	2.60	2.90–3.00	3.20–3.30
Contract miners	2.75–2.85	3.50	3.85

Common labor refers to the men who work in gangs, such as dump and track men and ordinary surface workers. Company account miners work for a flat daily wage, while contract miners are paid on a piecework basis, that is, for the amount of ore they turn out daily. The contract system has been one of the points under fire from the agitators. The root of this opposition is the same as that which inspires labor union leaders to oppose efficiency methods, bonus systems and scientific management.

The contract system encourages industry and efficiency and discourages the movement to set a flat wage for a certain group of laborers, regardless of their individual capacity or willingness to work. Left to their own devices, the bulk of the Lake Superior miners prefer the contract system.

The rate of pay on contracts is fixed at the beginning of each month. With most operators, this rate is never changed during the month except to increase it, regardless of whether a miner may be drawing a disproportionately large wage. Some operators have recently established a flat day rate on contracts which is paid regardless of how small the miner's output, but which is supplanted by the contract rate if the miner earns more on that basis. This flat day rate, in one instance, has been $3.50 a day, equal to the average rate which contract miners have been earning. The rate is effective only if the miner is still at work for the company on the following pay day. This system is really a day rate plus a bonus. One of the larger independents has announced a minimum wage, but by far the greater number of operators have not, although actually many have one in effect.

MAMMOTH STEAM SHOVEL IN NEW PLYMOUTH PIT, GOGEBIC RANGE, WHERE STRIPPING BEGAN ONLY A YEAR AGO

1917 *Labor Developments*

What developments may be expected during 1917 in the labor situation?

Let us sum up the favorable factors. The men are now drawing

THE SHENANGO PIT IS ONE OF THE DEEPEST ON THE MESABI

the highest wages they have ever received. The increases were granted voluntarily, a fact that has made a favorable impression on the men as it is concrete proof of the operator's desire to share their increased profits with their employes. The defeat of the strikers last summer will make such agitation less popular next summer. The men now are generally contented, and many of them are eagerly taking advantage of the present splendid opportunity to make money rapidly. The efficiency of the miners, in some few cases, has increased as the pay rose, indicating that some of the men are keenly alive to the excellent chances to increase their earnings. Mining organizations will be kept more nearly intact this winter, owing to heavier development work, thus insuring a larger nucleus of old employes in the spring.

The unfavorable factors center entirely around the presence of the outside agitators. Their success in fomenting trouble next summer is problematical. Although these people have endeavored to claim the credit for the raises granted last year, their influence at this time seems to be waning rather than waxing.

The situation last summer demonstrated that even a strike is ineffective in seriously holding back ore shipments. Open pit development work has been carried along steadily and is being pushed this winter, so that these mines will be in a position this year to forward an equal or, if necessary, a greater tonnage than in 1916. The agitators assert that they will organize the dock workers next summer, but there is little reason to believe their success along this line will be any greater than last summer, when they failed in their efforts to throttle the ore trade by this means. Success in lining up the employes of the ore carrying railroads is even more improbable. A large number of competent railroad men are now employed in switching work, or on open pit trains. Many of these, as well as other workers in the district, lost their regular railroad runs in the strike of some years ago and have been anxious to recover their old places. During the threatened national railroad strike early last fall, more than 80 men applied for jobs to the head of one division of one railroad.

In *The Iron Trade Review*, Jan. 6, 1916, it was pointed out that the miners would probably work more efficiently in 1916, owing to enforced prohibition in all of the iron ore country of Minnesota, except the Vermillion range and that part of the Mesabi lying east of Buhl. This prohibition resulted from the stipulations of an old treaty between the United States government and the Chippewa Indians, which made it unlawful to keep any intoxicating liquor within a certain specified territory, which includes those portions of the iron ranges indicated. After being forgotten for years, the treaty was found, fought and finally enforced on Dec. 1, 1915.

The labor troubles of last summer prevented a fair test of the changed conditions, but mining operators are a unit in stating that it has already had some benefit. The Indian agents of the government are charged with the duty of enforcing the prohibitory order. Despite the lack of co-operation on the part of some of the municipal authorities, which resulted in some cases in encouraging "blind tigers", the law is being strictly enforced. Businesses of other kinds now fill most of the old saloon blocks, and savings deposits have increased. Following the more strict observance enforced during the past few months, conditions are expected to improve still further. The prohibition supplemented the work of the operators, as the leading mining companies for years had been discouraging the consumption of liquor. With the ore districts operating at capacity next summer, a thorough test of the effect of prohibition on the efficiency of the men will be afforded.

An interesting sidelight on the disturbed conditions on the Minnesota ranges a few months ago, is the suspicion, freely voiced by some but scouted by others, that the trouble was fostered by certain groups interested in the success of the central European powers in the present war. Those who believe the report offer in support the fact that practically all of the men who walked out were natives of these countries, being largely Croatians, with some Austrians. The strike was under Austrian leadership, while the Finns and other nationals, held aloof. More than 90 per cent of the strikers were said to belong to a certain society which pays a death benefit of $1,000. It is alleged that at a meeting last summer, it was decided to withdraw the offer of a benefit from those members who had refused to strike.

The Oliver company is proceeding steadily with the development of its properties. The amount of stripping already done has placed this company in an excellent position for forwarding its usual large tonnage next

APPROACH TO THE BIG PENNINGTON PIT, CUYUNA RANGE

season. The biggest development work now being carried on by the Oliver company is the stripping of the Missabe Mountain property in the Virginia district. About 12,000,000 cubic yards of overburden will be removed, and several years will be required before the ore body is fully exposed. It is understood that the mine contains more than 55,000,000 tons of ore.

The Missabe Mountain mine is a state lease. It was formerly operated as part of the Virginia group, of which the other members were the Norman, Ohio and Lone Jack. The Norman has been worked steadily for some time and is approaching exhaustion. The Ohio and Lone Jack mines have both shipped, but the bulk of the ore in these properties is being held in reserve.

The Kerr mine, a new Oliver property which was formerly known as the Sheridan, shipped its first ore last season, about 500,000 tons. This mine is located west of the Hull-Rust. Shipments from this mine were delayed, as the railroad experienced considerable difficulty in getting its tracks through to the property. A 3-mile switch was built, a considerable portion of which is carried on a trestle, and by September the mine was able to get out ore.

Another large project being pushed by the Oliver company is the stripping of the Spruce-Cloquet property near Eveleth. This mine has been an underground property but will be converted into an open pit. Four shovels are now at work. In addition, two shovels are being employed to divert a stream which now flows across this property. This work involves an interesting engineering problem. The stream at times has a large flow of water, and in addition is used to carry off the sewage of the city of Eveleth. The stream will be diverted out of its original bed for about a mile, one-half of the way in an open ditch and one-half in a 9-foot concrete flume. The new pit, when fully stripped, will embrace portions of the Adams, Cloquet and Spruce properties. About 18,000,000 cubic yards of overburden remain to be stripped.

In the Adams district, stripping is under way at the Adams and Fayal properties. Development work at the big underground Leonidas mine is going steadily ahead. The Genoa, formerly an open pit, is being worked entirely as an underground property. The Minnewas mine is being changed over to an open pit.

The Oliver company opened up a new mine in the Virginia district the past season. This mine, the Ordean, adjoins the Shiras and is an open pit development. The Alpena mine in this district is now an underground mine as the open pit workings were practically exhausted last year. Three shovels are at work in the big Hull-Rust pit and the same number are stripping at the Sellers. Two shovels will be worked in the Morris pit. No work is being done on the big Carson Lake property. The draining of this lake was described in *The Iron Trade Review*, Jan. 14, 1915. The old lake bed is being filled in with overburden from the neighboring pits.

The independents, also, are employing the winter months to push forward extensive development plans. One independent which is preparing for heavy ore shipments next season is the Republic Iron & Steel Co. The Antoine Ore Co., in which the Republic company owns a half interest, has been carrying on considerable stripping at its Antoine (Clifford) mine near Iron Mountain, Mich. About 150,000 cubic yards have been removed, a rather large contract for the old ranges. The mine this winter is being opened underground in preparation for operation by the milling system. Three shifts are now at work. The mine will be electrically equipped. Two shifts are being worked at the Cambria mine of the Republic company on the Marquette range. The Iron River, Menominee range, properties of the company have not yet been developed.

On the Mesabi, the Republic company has reopened the Bray mine at Keewatin on the western end of the range. This mine was originally developed underground, but was later stripped. It will be worked now as an underground property, supplemented by some milling. The mine had been allowed to fill with water, which is now being pumped out.

The Union mine, a Republic property operated by the Union Ore Co., is now being changed from an open pit property to a milling and shaft mine. The ore will be loaded by revolving shovels into tram cars, hauled to the side of the pit and then hoisted on an inclined shaft up the side of the pit. The Republic company also is operating the Pettit, Franklin, Monica and Kinney mines.

Table II

Shipments by Ports and Railroads

	1916 Gross Tons.	1915 Gross Tons.
C. & N. W., Escanaba	5,349,596	4,060,728
C. & N. W., Ashland	6,723,118	4,134,000
C., M. & St. P., Escanaba	2,109,248	1,588,561
D., S., S. & A., Marquette	945,390	949,415
L. S. & I., Marquette	2,912,703	2,150,174
M., St. P. & S. Ste. M., Ashland	1,341,724	1,012,772
M., St. P. & S. Ste. M., Superior	1,279,064	960,595
N. P., Superior	417,012	173,048
G. N., Superior	11,091,010	7,209,150
D., M. & N., Duluth	21,837,849	13,437,419
D. & I. R., Two Harbors	10,735,853	8,642,942
Totals	64,742,567	46,318,804

Table III

Minnesota Ore Reserves and Assessed Values

County	May 1, 1915 Ore in the Ground Tons	Assessed Value	May 1, 1916 Ore in the Ground Tons	Assessed Value
St. Louis	1,232,058,841	$ 242,788,002	1,226,594,919	$ 249,129,433
Itasca	160,795,971	18,637,643	161,997,784	18,680,793
Lake	115,115	30,650	169,758	45,199
Crow Wing	72,215,605	5,711,739	77,072,354	6,228,306
Totals	1,465,185,532	$ 267,168,034	1,465,834,815	$ 274,083,731
	Ore in Stock Pile		Ore in Stock Pile	
County	Tons	Assessed Value	Tons	Assessed Value
St. Louis	6,611,138	$ 1,962,744	8,450,002	$ 3,063,722
Itasca	313,167	92,908	411,575	68,236
Lake	121,394	61,200	70,133	46,671
Crow Wing	187,460	42,381	340,469	69,635
Totals	7,233,159	2,159,233	9,272,179	3,248,264
	Total Merchantable Ore May 1, 1915 Total Iron Ore		Total Merchantable Ore May 1, 1916 Total Iron Ore	
County	Tons	Assessed Value	Tons	Assessed Value
St. Louis	1,238,669,979	$ 244,750,746	1,235,044,921	$ 252,193,155
Itasca	161,109,138	18,730,651	162,409,359	18,749,029
Lake	236,509	91,850	239,891	91,870
Crow Wing	72,403,065	5,754,120	77,412,823	6,297,941
Grand Totals	1,472,418,691	$ 269,327,367	1,475,106,994	$ 277,331,995

Its Schley property is idle. The company's total shipments for 1916 were about 1,295,000 tons.

On the Mesabi, M. A. Hanna & Co. are reopening the old Frantz mine near Buhl. This mine is an underground property. An interesting innovation in ore raising methods has been developed by this company and is being tried out at the La Rue mine, an open pit property, near Nashwauk. The ore is hoisted on a conveyor belt, being raised 315 feet in two lifts. The belt is rubber. It is 30 inches wide and operates on a 21-degree slope. The conveyor is electrically driven, a 20-horsepower motor actuating each section. Bins are now being built at the foot of the conveyor for storing ore, and the tram cars will drop ore by gravity into these bins. From the bins the ore will be discharged directly onto the conveyor. At the end of the first lift, the ore falls onto the second section, guards being provided to prevent the ore from falling off. An interesting computation has been made showing that this method of lifting the ore from the pit will save 3,600 train trips in one season, or about 12,000 train miles, as almost a 4-mile trip had been necessary to bring the loaded train from the pit to the washing plant, and the empty train back to a loading position in the pit.

Pickands, Mather & Co. will develop a new property this year in section 9, township 56, range 23. This property, which is known as the Sullivan, is immediately north of the Hill Annex mine. The tract was proved up several years ago and a contract has now been let for stripping. The work of removing the overburden will be started in the spring of this year and some ore will be shipped during the coming season. In all, about 1,000,000 cubic yards of overburden will be removed.

Considerable stripping will be carried on this winter at the Mace No. 2 and Bennett mines of the Meriden Iron Co., near Hibbing. The former mine was partially stripped last year and forwarded about 300,000 tons of ore in 1916. Additional stripping will be carried on during the next few months. The Bennett mine, which is worked by both open pit and underground methods, shipped more than 600,000 tons of ore last season and considerable stripping will be done this winter to prepare for a heavy movement next summer. Some stripping work will be done by the International Harvester Co. at its Hawkins and Agnew mines.

The Kingston Mining Co., Eveleth, Minn., has practically completed stripping its new Jean mine near that town. This property adjoins the Adams and Spruce mines and some ore was forwarded last season.

Developing the Hill Lands

The Great Northern ore trustees have proceeded vigorously with the development of their lands, including those properties turned back at the time the Steel Corporation surrendered the Hill lease. Although the Arthur Iron Mining Co., the trustees' mining subsidiary, shipped only 775,000 tons in 1916, development work on its properties has now reached a stage where a large tonnage can be forwarded next season. The Great Northern interests are understood to have taken interests in three vessels, thus insuring tonnage to carry part of their ore. The Hill Annex mine, the Arthur company's biggest property, will be ready to ship heavily this year if desired. About 5,000,000 cubic yards of overburden have been removed and 3,500,000 cubic yards are still to be removed. Part of the Hill Annex ore is of good shipping grade, and this will be sent forward first. The balance will be washed, but a washing plant will not be built until 1918. The company sold its new Alexandria mine to the Donner Steel Co. during the past year, but is operating this property for its new owner. This mine is an underground property, electrically equipped throughout. At the Dunwoody, about 6,000,000 cubic yards of overburden have been removed, uncovering about 5,000,000 tons of ore. About 3,000,000 more tons of ore will be uncovered in future stripping, but no work is now being done. Of the properties formerly operated by the Oliver company, the North Uno, Leonard and Harold are being worked underground this winter.

Development work of considerable interest is being carried on by A. B. Coates and George P. Tweed, particularly at the new Plymouth mine on the Gogebic range. This mine lies immediately adjacent to the Wakefield mine of M. A. Hanna & Co., being part of the same ore body. Stripping was begun just a year ago, and the mine shipped 325,000 tons last season. Only part of the ore body has been uncovered, and considerable stripping work will be done this winter. Four shovels will be kept at work steadily. These shovels are among the largest steam shovels ever constructed, being equal in size to the mammoth shovel employed by Butler Bros. in stripping the Mace Annex mine near Nashwauk, and which was described in *The Iron Trade Review* last year. The machines have a net weight of about 325 tons, and carry a 60-foot boom and an 85-foot mast. They cast up to a height of 60 feet and take a cut about 150 feet in width. The machines are reversible.

The other big Coates & Tweed property is the York mine near Nashwauk. This mine will be operated by the York Iron Mining Co. The ore is said to be primarily of bessemer grade. Stripping work will be completed by Feb. 1, and ore will be shipped this year. The work is being done by a Marion dragline excavator. This machine is equipped with a 115-foot boom, dipper and shovel boom. It is similar in all respects to the excavator employed in stripping the Balkan mine at Amasa, Mich., as described in *The Iron Trade Review*, Oct. 1, 1914, which was the first dragline excavator used for stripping work in the iron ore districts. The York pit will be rather small, and will be distinctive in that no approach will be built. In its place the ore will be removed in an electrically driven hoist,

TABLE IV

Shipments by Ports and Months

1916

Month	Escanaba	Marquette	Ashland	Superior	Duluth	Two Harbors
April	398,214	53,258	147,852	211,340	538,281	309,466
May	1,045,186	561,555	955,041	1,722,341	2,671,044	1,494,413
June	1,159,424	539,327	1,101,370	1,945,234	3,116,665	1,645,556
July	1,044,368	680,779	1,302,682	1,986,631	3,012,492	1,723,205
August	1,061,285	634,786	1,289,439	1,950,249	3,380,066	1,534,315
September	922,517	557,140	1,255,328	1,945,171	3,455,611	1,465,019
October	876,488	519,806	1,218,134	1,732,865	3,298,314	1,470,589
November	772,417	273,801	665,339	1,132,642	1,982,872	888,381
December	177,545	37,640	122,629	160,573	382,604	204,909

1915

Month	Escanaba	Marquette	Ashland	Superior	Duluth	Two Harbors
April	49,307	4,438	43,949	87,175	174,989	143,974
May	479,259	178,927	513,715	763,889	1,974,321	1,102,248
June	720,264	363,637	604,127	926,536	2,146,501	1,244,026
July	813,870	567,359	708,285	1,286,402	2,414,649	1,413,456
August	933,162	659,293	931,142	1,375,086	2,668,070	1,514,364
September	1,015,820	539,879	1,028,363	1,557,935	2,428,689	1,292,460
October	928,399	522,671	866,170	1,351,893	2,301,352	1,176,388
November	696,346	263,386	451,020	958,465	1,328,848	747,064
December	12,862	.....	.....	35,412	.....	8,962

running on an inclined shaft. The skips will be of 3-ton capacity. The hoist will be furnished by the Allis-Chalmers Mfg. Co. The shaft will be built at a 30-degree angle. The hoist control system is designed to be semi-automatic, doing away with a hoisting engineer. The two skips will be operated in balance and will be driven from one drum. After one skip is loaded, the man at the loading pit will press a button, starting the hoist. The loaded skip will be raised, and at the top of the pit, will stop and automatically dump its load. An emergency control system will be provided for stopping the hoist at any desired time, and auxiliary hand control will also be provided. The skips will dump into bins directly above the washing plant which is being built on the bank of the pit. This washer will be of the one-half unit type. Practically all the ore will be washed. The same interests control the Seville mine, which is not operating, but has some ore in stockpile.

Development work is being pushed by the Tod-Stambaugh Co. this winter at its properties on the Mesabi and Cuyuna ranges. At the big Pennington pit on the latter range, additional stripping is now under way. The company in 1916 shipped about 1,200,000 tons from Mesabi mines. The Dean mine forwarded nearly 1,000,000 tons of ore. Stripping work is now under way at this property and about 200,000 cubic yards of overburden will be removed this year. The Tod-Stambaugh company is opening up a new mine 3 miles west of Hibbing, which will be called the Warren. The Winston-Dear Co. is now stripping this property, and about 1,000,000 cubic yards of overburden will be removed. Some ore will be shipped this year.

Butler Bros. have extended their operations during the year. The new Smith mine was recently leased from the Hill interests. This mine contains about 700,000 tons of ore and is fully stripped but has not shipped any ore. It is near the North Uno. At the Lamberton mine, leased in 1915 from the same interests, stripping operations were conducted during the first seven months of 1916, and have recently been resumed. During 1916 Butler Bros. shipped about 300,000 tons from their new Kevin mine, a state lease sublet from the Hill interests. The stripping, which was partially completed last winter, is being continued now. West of this mine in section 2, township 56, range 23, is another new Butler property, the Patrick mine. Preparations are now being made for stripping this property. North of this mine is the Ann, on which no work has been done. The company is building an additional one-half unit at its washing plant near the Harrison, Quinn and North Harrison mines. The present plant is of one-half unit size, the addition thus giving the company a single-unit plant.

Ore Reserves Increase

Estimates of the tonnage of ore still remaining in the Minnesota ranges, indicate that there was a larger reserve on May 1, 1916, than on the corresponding date of 1915. The estimates were prepared by Rukard Hurd, director of the department of mines and natural resources of the Minnesota state tax commission. They are shown in Table III.

The ore estimated to be in the ground on May 1, 1916, aggregated 1,465,834,815 tons, an increase of 649,283 tons over May 1, 1915. On the same dates, Minnesota stockpiles held 9,272,179 tons and 7,233,159 tons respectively, an increase for May 1, 1916, of 2,039,020 tons. The aggregate tonnages, both in ground and stockpiles, on the two dates were 1,475,106,994 tons and 1,472,418,691 tons respectively, a net increase in 1916 of 2,688,303 tons.

While the increase is comparatively slight, it was made in the face of heavy shipments in 1915, and, furthermore, it is the first time in two years that the reserves have increased. The gain is due almost entirely to the greater reserves on the new Cuyuna range, which were increased through new discoveries. The older Mesabi range showed a loss of about 4,500,000 tons. The estimated ore in the ground in the Cuyuna range increased 4,856,749 tons, while stockpiles showed a gain of 153,009 tons, a total increase for the Cuyuna of 5,009,758 tons.

New Dock at Duluth

The Steel Corporation is continuing its policy of keeping its ore handling facilities in splendid condition to handle immense tonnages, as shown by its plans for a new dock at the D., M. & N. terminals in Duluth. A part of the new steel dock will be able to load ore by 1918. Pile driving has just begun. The new dock will have 384 pockets of 400-ton capacity each. The new dock, to be known as No. 6, will have the same number of pockets as No. 5, the last one built at Duluth, but each pocket will have 100 tons more capacity, an increase of 33 1/3 per cent. The new dock will easily be the largest loading dock in the world. It will replace the old wooden No. 2 dock. The new structure will be 84 feet high, 60 feet wide and 2,305 feet long. There will be a double track steel trestle approach 3,087 feet in length. The dock will be steel and concrete above the foundations, wood pilings being used below the foundations. The steel and concrete will be furnished by the Steel Corporation's new plants at Duluth. The completion of this dock will give the D., M. & N. two steel and two wood docks for handling ore and a small dock for limestone.

The new dock of the Steel Corporation's other ore carrying railroad, the Duluth & Iron Range, at Two Harbors, is nearing completion. This dock, No. 2, contains 228 300-ton pockets. This railroad now has three steel docks, Nos. 1, 2 and 6. Wooden docks Nos. 3 and 4 will be torn down in the near future, leaving No. 5 as the only timber dock. The Soo line will build a new dock at Ashland, Wis., while the Chicago & Northwestern is now carrying out an extensive program of improvements at the same city.

The mechanical developments of 1916 were associated principally with the problems of handling lean ores, and of improving the methods of hoisting ores from shafts or pits.

The efforts to solve the first problem resulted in the construction of a small washer at the Webb mine, the first plant operated in conjunction with an underground mine; changes and extensions at the experimental washer at the La Rue mine; the beginning on a big scale of tests to determine, if possible, a commercially successful method of handling the magnetite ores of the eastern Mesabi; and the installation at the Susquehanna mine of a rock separator, designed along original lines.

For hoisting ores from open pits, several installations of conveyors and hoists have been made, as described in foregoing paragraphs, while the York mine, as pointed out, will not have any approach, and a semi-automatic hoist will be used to lift the ore from the pit to the bank.

The drift toward greater use of electric power continues. Plans have been approved by the Oliver Iron Mining Co. for the electrification of the Norrie-Aurora group of mines on the Gogebic range. In all, 10 shafts of this group will be equipped with electrical equipment throughout. Pickands, Mather & Co. will install electrical equipment at their Mesabi mines, this work now being under way at the Albany and Utica mines. The Antoine (Clifford) mine, Menominee range, owned jointly by the Republic Iron & Steel Co. and the Shenango Furnace Co., will be equipped this winter with an electrically driven hoist and pumps. A crusher will be installed and will be electrically driv-

en. The power will be purchased. The Union mine, Mesabi range, also will be electrically equipped this winter, power being purchased from the Great Northern Power Co., Duluth. Electric hauling equipment was installed this year at the Deacon, Wanless and Shiras mines of the Oliver company, in the Virginia district. The Alexandria mine, Chisholm, operated by the Arthur Iron Mining Co., a subsidiary of the Great Northern Ore trustees, which shipped last year for the first time, is operated throughout by electricity. The Great Northern Power Co. has been extending its lines to the additional points on the Mesabi range. The employment of electric power is constantly on the increase on all of the Minnesota, Wisconsin and Michigan ranges.

One additional washing plant was built in 1916 for handling the western Mesabi ores. This plant, the sixth in that district, is at the Webb mine of the Shenango Furnace Co. This washing and concentrating plant has the distinction of being not only the smallest on the range, but also the only one operated in conjunction with an underground property. Some of the ore mined was becoming too fine and it was decided to install washing and concentrating apparatus. The equipment was furnished by the Allis-Chalmers Mfg. Co., Milwaukee, Wis. The operation of this plant is being watched with considerable interest by a number of other mining companies who are encountering similar problems in their mines.

New Plants Going Up

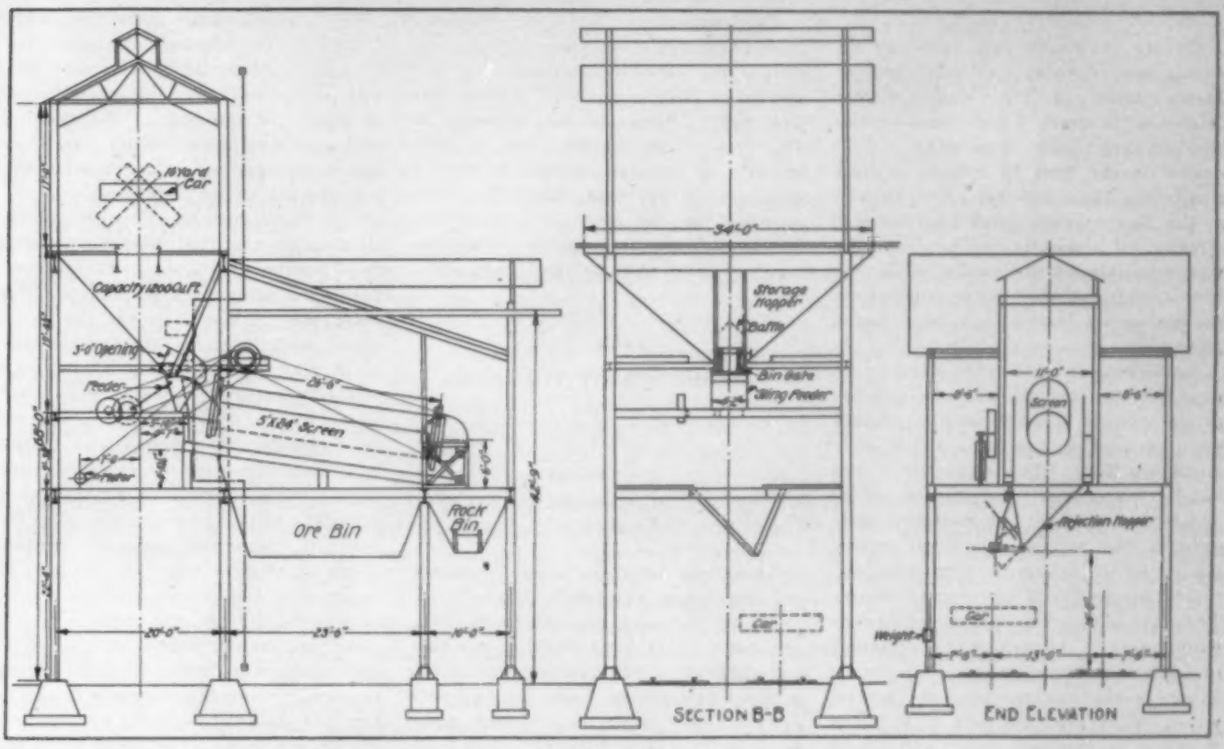
The success met during the past few years in washing and concentrating the typically sandy ores of the western Mesabi has assured the construction of additional plants. The new Cleveland-Cliffs plant at the Crosby mine has finished its first season of operation with satisfactory results. This is a one-half unit plant. A. B. Coates and George P. Tweed are installing a plant of the same type at their new York mine near Nashwauk. This will be a one-half unit plant. Practically all of the ore will be washed.

La Rue Washer Improved

Some changes will be made at the experimental washer operated by M. A. Hanna & Co., at the La Rue mine, Nashwauk. A turbo-log washer will be installed this winter, and will operate in conjunction with the Woodbury jig, log washer and Weatherbee concentrator employed since 1914. This arrangement will enable comparative data to be obtained on the relative efficiencies of the two types and at the same time will increase the capacity of the plant. During the season of 1916, about 350,000 tons of La Rue ore was run through the plant and about 260,000 tons of concentrates secured. This was the first season that the plant ran at capacity, only about 25,000 tons of ore being handled in 1915. Experimental runs had indicated that a recovery in iron units ranging from 80 to 85 per cent could be secured, and these results were proved true during the past season. This plant is designed to use a minimum quantity of water. The big Trout Lake plant of the Oliver Iron Mining Co. was operated at capacity during the year.

Tests are now being carried on in Duluth to ascertain, if possible, a commercially successful method of handling the magnetite ores of the eastern Mesabi. Experiments had been conducted at the school of mines, University of Minnesota, on a magnetite washing apparatus and it is said that a scientifically satisfactory process had been developed. These experiments, of course, were carried out for scientific and not commercial reasons, and the Duluth tests are being run to determine the commercial possibilities of using these eastern Mesabi ores. We are informed that the tests indicate that operations can be successfully carried on with ore prices at their present level, but the success or failure of the tests, hinges, of course, upon the commercial practicability of the process with much lower ore prices.

A problem, allied to that of washing and concentration is that of rock



CROSS SECTION OF SEPARATOR AT SUSQUEHANNA MINE

separation. This problem has gained steadily in importance as some of the open pit properties have become well developed. As pointed out in previous articles in *The Iron Trade Review*, mine operators as a rule would prefer to take out the rock streaks and ore with a steam shovel, and stock the mixture as a lean ore reserve. The fee owners, in some cases, prefer to have the ore separated, an operation that approximates underground costs if the sorting is done by hand ahead of the shovel. Butler Bros. have been using a rough separating apparatus employing a grizzly.

New Rock Separating Device

During the past year, a screening device was developed at the Susquehanna mine of the Rogers-Brown Iron Co. to meet a condition similar to ordinary rock separation. This device is the first to eliminate practically all hand picking. The shovels at the Susquehanna mine had run into streaks of taconite. This taconite was encountered in chunks, while the ore is soft. Under these conditions, the screening device has been found admirably adapted.

As shown in the cross section on page 95, the taconite and ore mixture drops onto a grizzly with a 24-inch opening and thence into a bin with a sloping floor. The screen will thus handle material of any size up to 24 inches in diameter. A movable gate permits the mixture to flow onto a feeder, which is merely a moving sector. This feeder is electrically driven. The gate is supervised by a workman, who raises it to permit the passage of unusually large rocks. The feeder advances the mixture into the screen, which is of the open-end type. The cylinder is wrought iron and is 60 inches long and 24 inches in diameter. It is provided with a great number of 2-inch openings through which the ore falls into the ore bin below the screen. The screen is tilted 1¼ inches to a foot. It is revolved at a speed of 15 revolutions per minute by a 30-horsepower motor functioning through gears. This motor also drives the feeder through a countershaft. The taconite, freed from the ore, rolls down to the lower end of the screen where it falls into the rock bin. The gate of the rock bin is operated by compressed air, those on the ore bins being actuated by hand.

The screening plant is located at the head of the approach, and is set over two tracks. The ore bin discharges into cars on one track and the rock bin into cars on the other. The equipment was furnished by the Allis-Chalmers Mfg. Co. from designs furnished by the Rogers-Brown company. This screening plant treated 133,740 cubic yards of rock and ore during 1916, and recovered 190,656 tons of ore and 42,694 cubic yards of rock. This plant was erected after an agreement was reached with the fee owners by which material under 2 inches is classed as ore and that over 2 inches as rock. This classification is said to be remarkably close, as probably 75 per cent of the ore is 1 inch or less in size.

In connection with the screening plant, the mining company also built this year a coal storage bin, as shown in the illustration on page 88. The locomotives are coaled by gravity.

The unsatisfactory, and in some cases unsavory, condition in regard to municipal taxes and expenditures has not improved materially during the past year. Attention was directed in *The Iron Trade Review*, Jan. 6, 1916, to this unfortunate situation and it was pointed out that "taxes for state purposes on the iron ore industry in Minnesota are not burdensome, but local county and village taxes, particularly the latter in some instances, are becoming extremely heavy." In one city, Hibbing, a compromise was effected a little more than a year ago, by which the 1916 assessments of the mining companies (who pay practically all the taxes) was scaled down from $1,900,000 to $750,000. The mining companies in return paid their 1915 assessments in full, while the city authorities agreed to limit the city's general expenses to $24,500 a month.

Table V

Reserves by Ranges

	1915 Tons	1916 Tons
Mesabi	1,389,003,652	1,384,636,891
Vermillion	11,011,974	13,057,280
Cuyuna	72,403,065	77,412,823
Totals	1,472,418,691	1,475,106,994

The city's general expenses are said to have run consistently above the agreed sum, while no halt has been called in the ambitious and extravagant schemes for municipal "improvements". The 1917 assessment, consequently, has been boosted 33 per cent, or from $750,000 to $1,000,000, while, in addition, an expenditure of $125,000 has been authorized for a new library, to replace the present substantial $25,000 Carnegie library. Land also has been purchased for a municipal abattoir. The situation is discouraging to all those interested in the careful and economical administration of the city's affairs. During the year some of the leading officials of Hibbing were arrested on charges growing out of the unsatisfactory situation. An illustration of what seems to be a deliberate attempt to bait the mining companies, is afforded by the decision of the authorities of Hibbing to erect a municipal heating plant, at a cost of $500,000, directly above a valuable ore deposit. The plant is to replace a smaller one. The ore deposit is directly between the big Hull Rust-Mahoning and Burt-Sellers pits, and will be worked within 10 years at the most. The effort to construct the city heating plant directly over this ore has been held up, the mining companies having secured legal relief temporarily enjoining the authorities from proceeding with their scheme.

The Cuyuna range forwarded 1,696,076 tons last season, compared with 1,136,113 tons in 1915, its banner year. The shipments have increased steadily since the opening of the range in 1911 and development work now under way indicates that a larger movement may be expected this year.

The Northwestern Improvement Co., allied with the Hill interests through the Northern Pacific railroad, will develop a property adjoining the Hillcrest mine, known as the Feigh. A shaft, with outside dimensions of 13 x 18 feet, will be sunk. The westerly 660 feet of the property has been leased to the Hill Mines Co., and will be hydraulically stripped and worked in conjunction with the Hillcrest property. This portion contains about 1,500,000 tons of ore while the balance of the Feigh property contains about 5,500,000 tons. It is not believed that the Northern Pacific interests will operate the mine.

An interesting sidelight on the effect of the war on the mining districts, is seen in contracts recently drawn up for the sale of some Cuyuna manganiferous ores. It is understood that some of these contracts call for 20 cents, and higher, for a unit of manganese. Some of the ore now being mined runs about 20 per cent in manganese. A fair tonnage of manganiferous ores was shipped last season from several properties on the range.

A number of new properties were opened up on the Cuyuna last year and a number of drills are now at work on both the northern and southern ranges.

H. L. Lautenschleger, chief of the materials follow-up department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, now directs the purchase of castings for the company. He recently was elected secretary of the Veteran Employes' Association, which includes employes who have been in the service of the company 20 years or longer.

STEEL is soaring—literally. We have become accustomed to the wild similies springing from the minds of writers dealing with steel market conditions during the period of phenomenal activity since all Europe burst into bedlam, but to say literally that steel is soaring is the truth in speaking of the modern aeroplane. The self-propelled, heavier-than-air machine was, at the time of its conception, and in fact is at the present time, restricted in its development by the need of motive power that combines extraordinary power with unusually light weight. The Wright brothers first discovered the solution of the problem in the gas engine and the world was astounded when they succeeded in building a machine that remained in the air for more than an hour. The aeroplane and the production of high grade steel have been improved to such an extent during recent years and progress has been so great that the world looked on with but mild interest when recently an aviatrix, Miss Ruth Law, flew without landing for six hours and covered a distance of 590 miles. The importance of steel to successful flying may only be realized after one appreciates the extreme care that is taken in the handling and treatment of the metal which is used in the engine and in the construction of the frames of the aeroplanes made at the factories of the Curtiss Aeroplane Co., Buffalo, N. Y.

Importance of Weight in Flying

But to show how important the question of weight is in flying, consider these average figures: One square foot of wing surface is needed to lift six pounds, and one horsepower is required to lift from 20 to 25 pounds. Because the engine is by far the heaviest single element of the aeroplane, it readily may be seen that the problem remains now as it was at first, to increase the power and at the same time to decrease the weight of the power plant. Science has accomplished wonders in producing high quality steels and in progress along these paths the latest gas engine for flying machines is the last milestone. The new Curtiss engines, with their cast-steel cylinders, chrome-vanadium connecting rods and chrome-nickel crank shafts, develop 210 horsepower and weigh but 600 pounds—about three pounds per horsepower.

Although the steel in the engine outweighs that used in the bracing and reinforcing of the body or fuselage and in the wings of the Curtiss machines, yet the need for dependable strength is so great that the most minute part is treated with the same extreme care that characterizes the production of the engine parts. The framework of the fuselage and wings is made of spruce, but where the various parts are fastened together and where the moments of stress and strain are centered steel is used. In the parts of the machine that require bracing, stranded steel wires or Shelby seamless steel tubing are employed. The turnbuckles and the clips that are necessary in fastening and tightening the stranded wires are all forgings which have been heat-treated. In general, the steel used in aeroplane construction is typified by its high tensile strength and its great resiliency. The standard in all phases of design is to provide for the safety of the operator and passengers in the machines. This is more essential in the construction of flying machines than in the building of vehicles for any other mode of travel because a failure of one or more parts seriously imperils the lives of those in the machine.

THE ELECTRIC FURNACE IS OF THE RESISTANCE TYPE—A HEAT-TREATING PLANT IN MINIATURE

Excellent Research Department

The engineering department of the Curtiss Aeroplane Co. is directed by Dr. A. F. Zahm, who was affiliated with the Smithsonian Institute for some years and who has done considerable work for the United States government as aeronautical advisor. He is one of the best designers of aeroplanes in the country and is the author of several texts on this subject. The department, of which Dr. Zahm is the head, handles all problems relating to research, design of motors and planes and inspection.

A CORNER OF THE CHEMICAL LABORATORY—THE CHEMISTRY OF STEEL IS OF THE GREATEST IMPORTANCE IN THE CONSTRUCTION OF AEROPLANES

The steel that is used is selected, treated and tested under the specifications of the research department. This branch of the engineering department is subdivided into several divisions. Of these the chemical, heat-treating and structural testing divisions test the samples of raw material, prescribe the method of treating it and finally test the finished product. Most of the steel employed in the manufacture of aeroplanes is purchased from jobbers at the present time under specifications of the research department. The company, however, buys some of its steels directly from the mills and plans to extend this practice in the future because of the advantage gained in having the influence of its research department exerted through as many stages of production as possible. In general, the company purchases five different kinds of steel.

Protecting the Aeroplane User

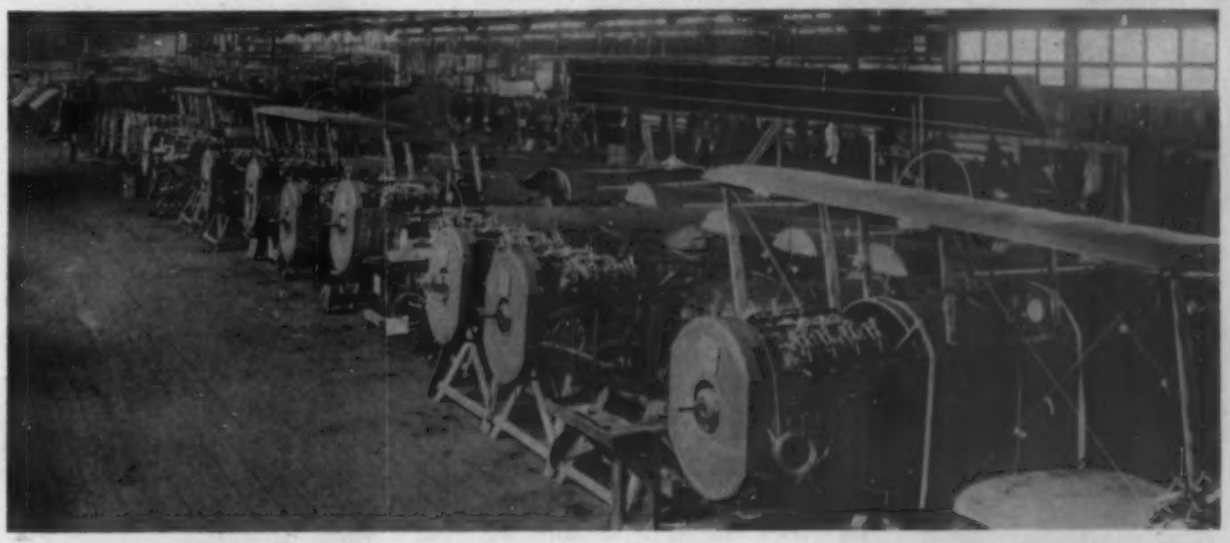
When an order of stock is needed a jobber supplies the company with a sample cut from the stock desired. Half of this sample is sent to the machine shop where drillings are prepared for the chemical laboratory and a piece is turned to the proper shape for the physical testing laboratory. Half of the sample is preserved and filed under the same number that identifies the test samples. These samples which are filed are held for about six months and serve as a means of checking the results of the research department should any questions arise after the stock has been purchased and used in the machines. If the chemical analysis of the sample is approved and if the stock is free from cracks and similar physical defects; in other words, if the samples agree with the specifications, the department issues the purchasing order.

The connecting rods of the engine are made of chrome-vanadium steel having an average composition of 1 per cent chromium, 0.18 per cent vanadium and 0.45 per cent carbon. The percentage of sulphur and phosphorus is restricted to 0.035 per cent. These rods have a tensile strength of 160,000 pounds per square inch. The elongation is approximately 12 per cent with a 50 per cent reduction in area. Despite the high tensile strength of this part, which ordinarily does not accompany the quality of ductility, the connecting rods are extraordinarily ductile, as may be seen from the group of connecting rods on the ta-

THE HEAT-TREATING LABORATORY IS WELL EQUIPPED—THIS DEPARTMENT SPECIFIES THE METHOD OF HANDLING THE HEAT-TREATING OF ALL PARTS OF THE MACHINES

bles in the view of the heat-treating laboratory. This shows the forging, the finished rod and a rod that has been severely twisted without developing serious cracks. The strongest feature in favor of the use of chrome-vanadium steel is its resistance to fatigue under high stress. This resistance is not so pronounced, however, in comparison to other alloys when the stress is lowered.

Chrome-nickel steel is to be found in many parts of the engine and in the control apparatus of the plane where friction is to be resisted. In the engine, this alloy is used for piston pins, connecting-rod bolts and for the crank shaft. Chrome-nickel pins are used in the hinges for tilting the planes and in similar places on the



THE MAIN ASSEMBLY FLOOR—THE FUSELAGE OF THE MODERN AEROPLANE CLOSELY RESEMBLES THE BODY OF AN UP-TO-DATE MOTOR CAR

operating mechanism of the machines. The chrome-nickel alloy is made up of 3½ per cent nickel, 1½ per cent chromium and 0.50 per cent carbon. Its ultimate tensile strength is 210,000 pounds per square inch and its elongation 10 per cent. In the case of chrome-nickel steel it is pointed out that a large percentage of elongation is not particularly desirable in such metals which are heat-treated because the steel should not take a permanent set when under stress but should be resilient and return to its original shape or form.

Cast Steel Engine Cylinders

All the bolts and similar pieces for the engine and other parts of the plane are made of 3½ per cent nickel steel with the exception of those which are made of the chrome-nickel alloy. The 3½ per cent nickel alloy is also employed in the axles and axle tubing of the running gear which is used in landing. Perhaps the most important part of the plane in which nickel steel is used is the engine cylinder. To make the cylinder for the eight-cylinder, 210-horsepower engine, a solid billet is machined to a 3/32-inch wall, leaving ribs for strengthening purposes. This cast-steel cylinder is covered with monel metal which protects it from the water of the cooling system. The complete cylinder with its protective covering weighs but 13¼ pounds.

High-Grade Carbon Steel Used Freely

Use is found for a large amount of ordinary high-grade carbon steel in the modern aeroplane for numberless small forgings and stampings that are necessary in the assembly of the planes and car. Shelby seamless steel tubing is used to brace the wings and for reinforcing the fuselage, tilting planes and rudder. The forgings are employed to fasten the wire bracings to the framework. Stampings are to be found where sections made of wood are to be joined together, particularly in the fuselage and in the biplanes or polyplanes, where the sets of planes are fastened, one to the other. The accompanying view of the heat-treating room shows a group of these forgings and stampings. The connecting rod at the rear is made from a solid forging. Two rods which were severely twisted after heat treating may be seen in this group. The exhaust valves are made of tungsten alloy steel to resist the heat and preserve wearing qualities.

When the physical testing division receives from the chemical laboratory the results of an analysis on a specimen of stock, if the stock is familiar and if the proper heat treatment has been previously determined, the metal is accepted and the subsequent treatment of it prescribed from the data and information at hand, providing the results of the chemical examination are satisfactory. However, if the stock upon which the chemical laboratory has reported is unknown, the physical testing laboratory makes a series of heat-treating tests to determine the best treatment to secure the results desired. These tests are carried on in an electric laboratory furnace of the resistance type. The method of heat treating may be estimated to some extent from the results of the chemical analysis. To determine the tensile strength of the test piece, the laboratory has at its disposal two Riehle testing machines, one having a capacity of 20,000 pounds and another of 100,000 pounds capacity. On new stock, if the chemical and physical tests fall within the requirements, and if the steel shows the desired results after the heat-treating experiments, an order is given for its purchase. Further tests to determine the fatigue and other qualities of the steel are made if considered necessary. The testing laboratory is equipped with two kinds of hardness testing machines and photomicrograph apparatus in addition to the apparatus already mentioned.

Adding Safety by Heat Treatment

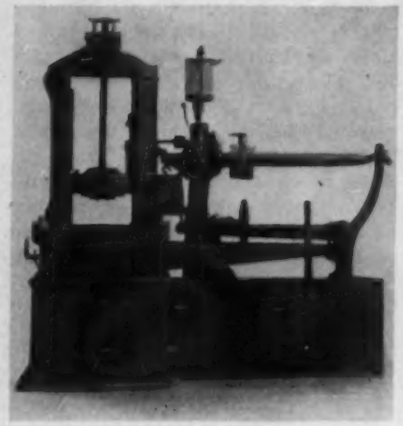
The value of heat treating is well emphasized in the construction of heavier-than-air machines where it is essential that each part be of maximum strength and minimum weight. Steel is used to the limit of its strength, but at the same time the

factor of safety is not reduced. If the weight of a piece of steel is reduced it means that science has taken another stride and that the maximum strength of the steel has been raised again by an improved method of treating it. That part remains as safe or is made safer than ever. The manner of heat treating is prescribed by the testing department and is sent with each order of stock to the heat-treating room. All forgings are heat treated and double quenched in oil. The procedure is to heat the piece beyond the critical temperature after which it is quenched—slowly if the part is liable to crack. After this is

A BRINELL MACHINE FOR MEASURING THE HARDNESS OF AEROPLANE STEELS

done, it is reheated slowly until the critical temperature is reached. It is not allowed to remain in the furnace at this temperature for more than five minutes. By heating the pieces slowly, a uniform temperature is secured through all parts of the piece under treatment. The connecting rods are quenched in oil at 1,550 degrees Fahr. and drawn to 900 degrees Fahr. They are then started in the furnace at 1,200 degrees Fahr and heated for 1½ hours to bring them to 1,550 degrees Fahr., after which they are drawn for one hour and cooled in still air.

The furnaces used in connection with this work are made by the Belleview Industrial Furnace Co., Detroit. The quenching and drawing is also determined by the research department. In measuring the hardness of



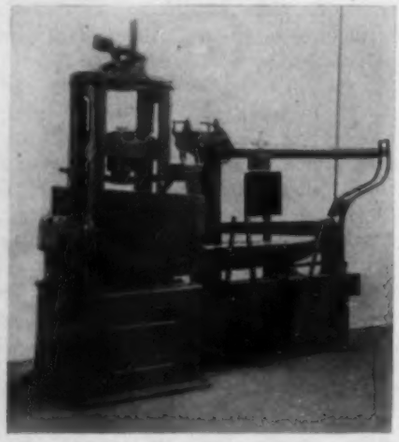
ONE OF THE TWO LARGE TESTING MACHINES IN THE RESEARCH LABORATORY

the stock, the Brinell testing apparatus is used as a master, the scleroscope being used as a check. For example, if a piece of steel is measured by both methods at various degrees of hardness, experience has proved that there will be no uniformity between the two sets of results, but the readings should be consistent at any one degree of hardness.

Heat Treating Screw Stock

The screw stock is generally heat treated in the bar form. If the screws are treated after they have been cut, they are first copper plated. The coating is removed after the screws have been taken from the furnace by running them through a die. The stampings of sheet steel which are used in the construction of the frame work are first annealed and then stamped. After stamping they are heat treated.

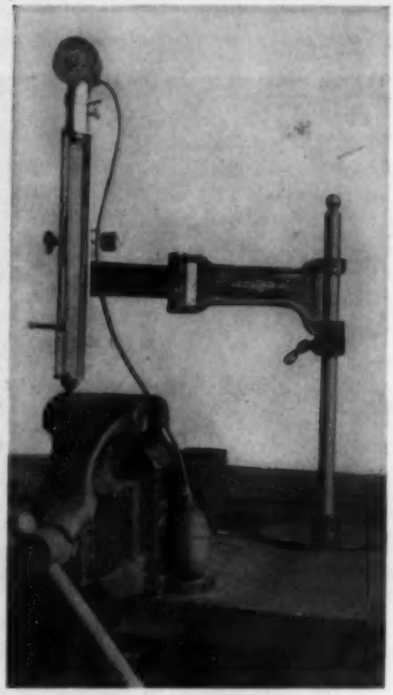
Great care is exercised to protect the metal parts of the machines against corrosion. The most satisfactory method has been found to first plate the parts with copper and then on this foundation several coats of nickel. A number of coats of fine



TESTING TUBING FOR AN AXLE

japan are then applied, providing a protection that is said to be reliable in withstanding corrosion under the most severe condition—that of contact with sea water.

Engineers at the Curtiss plant maintain that more has been accomplished in the science of flying during the war than would ordinarily be accomplished in a period of 10 years. It is not safe to prophesy the future of the aeroplane, not because of liability to exaggerate, but because the possibilities are so great that one's imagination is scarcely broad enough to comprehend all that may be done with these frail appearing machines. Certainly



THE SCLEROSCOPE IS USED AS A CHECK IN MEASURING THE HARDNESS OF THE STEELS

aeroplane traveling offers more scenic advantages that any other mode. There is the absence of noise and dust; it offers the shortest route and the highest speed, and, furthermore, the aeroplane will go to the inaccessible places of the earth where the trains and ships are stopped miles away. There are possibilities for its use in the weather department to make observations, in the geographic department in making forest and coast surveys. Floods or earthquakes do not delay the flying machine, and now with science safeguarding the most infinite part, it promises to become the safest method of traveling, for with the aeroplane collisions are almost impossible, no track is to be depended upon and the causes of most of our serious traffic accidents are eliminated.

Contrasts Methods

British Foundryman Compares English, German and American Plants

"Backward British Foundries" was the subject of the address of J. Shaw, president of the Birmingham branch of the British Foundrymen's Association at a recent meeting. Mr. Shaw is a member of the American Foundrymen's Association and in the course of his address referred in appreciative terms to the literature he received from the American association. Opening his talk, Mr. Shaw said that he believed it would pay the association to consider the conditions obtaining in the industry in 1914 before the war in order to see what readjustments will be needed for the British foundry trade to hold its own at the end of the war. He pointed out that both America and Germany are making every preparation for the keen competition which is expected to follow the war. To illustrate the need for progress in the foundries of England, he gave a number of statistics which all seemed to vindicate the statement that the English were not making the same progress as their competitors.

The causes for this, Mr. Shaw endeavored to explain by comparison particularly with the American and German foundries. He said that the diversity of work done in English foundries produces better molders, but at the same time added more to the cost of production than the practice of specialization which is so closely followed in the other two countries. The introduction of labor-saving devices results in an enormous saving of labor and expense of which the British foundrymen have so far failed to take advantage.

The British Isles, as pioneers in the iron and steel industry, have the disadvantage of old and obsolete plants. Of the 170 foundries in the Birmingham district, Mr. Shaw stated, but very few are built on new and modern lines. Of the 36 shops in Birmingham, but 5 per cent have railroad sidings. The shops are badly lighted and ventilated and are deficient in crane equipment. Owing to this condition and the difficulty of rebuilding while the war is in progress, Mr. Shaw was not very optimistic about the position of the industry at the termination of the world struggle.

The industrial organization of Germany next occupied the speaker's attention. The advantages of the German organization as appreciated by the English may be gaged to some extent by the disadvantages of this system which were pointed out by the speaker. "The disadvantages of overindustrialism are: Grasping for new markets, political intrigue, unemployment in periods of depression and in addition to this, the means taken to minimize the unemployment, that is, the promotion of overseas undertakings which almost always embroils the country in political difficulties." Another feature of English foundries which is a detriment to the industry is the large number of very small plants in comparison to the many enormous plants in other countries. Mr. Shaw firmly believes in the corporation plan which fosters large industries and places them in a position to employ the best of scientists and install the latest and best labor saving devices.

From the standpoint of both the workman and the industry, J. Shaw believes that the trade unions are valuable. The restriction of output by the British trade unions is, however, in direct opposition to the policy of the German and other unions, which favor increased production because it results in higher wages for the members. In conclusion, the speaker dwelt on the difference in the education of the workers in the different countries, and, pointing out the repugnance of the English workingman to compulsory education, urged all the members of the association to do their utmost to overcome the prejudice of the men in this regard. He suggested that the association could be influential and could guide various educational committees in any classes started for foundry instruction.

Electric Furnace Motors

THE commercial field for the electric furnace has recently been broadened to no little extent by improvements in furnace design and by the extensive reduction in the cost of electric power. Years ago, electric furnaces were used in the steel industry, principally for the refining of high grade alloy and tool steels. They are now widely used, not only for this purpose, but for refining common grades of steel. This has been made possible not only by the reduction in power costs, but also by the improvements that have been made in blast furnace design and in the method of operating the furnace. In steel foundries, the electric furnace is being used largely for melting, although a limited amount of refining is also being done.

The electric furnace of today differs widely from the older types. Costs have been lowered by the use of larger furnaces and improved devices for charging and tilting and perfected automatic regulation have all tended to introduce greater economy. Of the two types of electric furnace, the induction and the arc types, the latter in sizes from ½ to 20-ton capacity, has been adopted almost exclusively in this country. Of the auxiliary equipment needed by this type of furnace, which includes transformers, line protective equipment, switch board, furnace tilting motors, regulating systems and motors for adjusting the positions of the electrodes, that equipment which is required for tilting the furnace is of unusual interest. On large electric furnaces of the tilting type, the rocking mechanism is operated by a motor, which may be either alternating or direct-current type, but generally has characteristics similar to motors used for hoisting service. The controller for this motor is of the reversing type and a motor brake is adopted to prevent over travel of the furnace and to hold it in any desired position. Motors of this kind, ranging in size from 15 to 150 horsepower, and equipped with controllers and brakes are manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Where automatic control of the electrodes is desired, a motor-operated hoisting mechanism is provided for each of the electrodes. Shunt-wound direct-current motors have been found desirable for this purpose because of the relative simplicity of their controling apparatus. One of the greatest improvements which characterizes the modern electric furnace is the feature of automatic regulation of the current. The object of the regulating system is to automatically maintain a constant current at the furnace. Among the advantages of this regulation may be included large savings in labor charges, efficiency of current utilization, shortening of the period of operation and, due to more suitable furnace conditions, an improved product. The basic principle of the regulator is that of the Thury device, which has been described in a previous issue of *The Iron Trade Review*.

The Cambria Steel Co., it is reported, will erect a plant for the manufacture of car wheels at Johnstown, Pa.

Big Mergers Put Through in 1916

Charles M. Schwab and William E. Corey Were Principal Figures in Bethlehem and Midvale Combines—Corporation Faced by Strong Independent Groups Will Meet Stiff Competition After the War

BY JOHN GOLDSTROM

ANDREW CARNEGIE'S reveries on New Year's Eve must have afforded him a few reminiscent chuckles. In 1916 two of the most aggressive and active among his "boys", Charles M. Schwab and William E. Corey, had been at it again. For weeks rumors of mergers filled the air. Some thought the "good old days" of the decade between 1900 and 1910 were about to return. When the smoke of battle finally cleared away, it was found that mergers were by no means as plentiful as Wall street prophets had predicted. Nevertheless two new Goliaths of steel stood forth, the Midvale Steel & Ordnance Co., headed by William Ellis Corey, and the Bethlehem Steel Corporation, led by Charles M. Schwab.

Mr. Corey scored first, on Feb. 7, with his merger of Midvale and Cambria; but 11 days later his old friend was heard from when Bethlehem took over Pennsylvania Steel and Maryland Steel. The effects of these two great combinations remain yet to be accurately determined. A number of other mergers and combinations of importance to the steel industry were effected during the year; but the Schwab and Corey deals stand out by themselves as landmarks. Both transactions were inspired by industrial demands growing out of the war. It was war's urgent demand for steel that brought Mr. Corey out of retirement and sent him hurrying back over the Atlantic to organize the Midvale Steel & Ordnance Co. at Philadelphia. It was the insistent demand for greater production, also, that led Mr. Schwab to search the highways of commerce for the independent stockholder. The two mergers form a fitting culmination to two careers that have moved parallel since both Mr. Corey and Mr. Schwab were boys in Carnegie's Homestead works.

These two "boys" of Carnegie's who figured so largely in the earlier successes of the Steel Corporation, now are the corporation's greatest business rivals. They are competitors of the Corporation, and against each other, in practically every department of the steel industry and are likely so to be to a greater extent after the war. At present there is more than enough business for all; afterward, competition is bound to be keener. Mr. Schwab has declared that war business is secondary to the business that peace should bring to this country after the war.

THE MERGER WIZARD OF 1916

Chas. M. Schwab, chairman, Bethlehem Steel Corporation, which, through purchase of the Pennsylvania and allied steel companies, last year, became the country's largest independent steel producer.

The relative positions of the big Corporation and the two large independents after the war is a matter for speculation and prophecy by long-shot prophets. Only by a flight of fancy can it be imagined what might happen if the Schwab and the Corey interests would combine for massive competition with the Steel Corporation, but these are days when the stuff of which dreams are made often is converted into tangible realities. If the principal events of the steel business in the last three years had been prophesied on New Year's, 1914, the doors of some quiet and restful sanitarium would have swung wide for the prophet.

The first formation of the Midvale Steel & Ordnance Co., out of the Midvale Steel, the Worth Brothers, the Remington Arms and the Buena Vista Iron companies, is 1915 history. In October of that year the company was capitalized at $100,000,000, which subsequently was increased to $150,000,000. Its acquisition, on Feb. 7, of the Cambria Steel Co. at a cost of $72,900,000, from William H. Donner and a syndicate headed by J. T. Replogle, gave it its largest unit. How this deal followed a failure to merge Cambria with the Lackawanna Steel Co. and the Youngstown Sheet & Tube Co., and the details of the successful merger, are familiar to the steel industry. After taking over Cambria, Midvale became a manufacturer of all the most important steel products except sheets, tin plate and tubes. Cambria added to the Midvale output, merchant steel bars, structural shapes, wire, nails, axles, nuts, bolts, rivets, shafting, etc. The works, together with a car-building plant, are near Johnstown. The Cambria output was 1,715,000 tons of pig iron, 2,350,000 tons of steel ingots and 1,900,000 tons of finished products, from eight blast and 26 open-hearth furnaces, four bessemer converters and a battery of bar, structural, shape, plate, rail, axle and wire mills.

With Cambria also came a Great Lakes steamer line and extensive ore properties on the Lake Superior ranges, the most important being a half interest in the great Mahoning mine on the Mesabi range. Through subsidiary companies Midvale had come also into con-

trol of large coal and limestone properties and now was the unquestioned leader of the independents.

But Midvale's leadership, among the independents, lasted about as long as a Mexican president. Eleven days after the deal, Mr. Schwab, on Feb. 18, celebrated his fifty-fourth birthday by taking over the Pennsylvania Steel company, Steelton, Pa., and its subsidiary, the Maryland Steel Co., Sparrows Point, Md., at a total cost of $31,941,630, from William H. Donner and Pennsylvania railroad and Reading Co. interests. Mr. Donner had also been a prime mover in the Corey purchase. He takes rank as one of the greatest all-'round merger engineers in the steel business.

The Pennsylvania Steel property included blast furnaces, steel works and finishing mills; the Maryland plant consisted of blast furnaces, steel works, rail and billet mills and a shipbuilding plant. The Pennsylvania company, through its subsidiary, the Spanish-American Iron Co., owned and operated large iron ore deposits in Cuba. The Sparrows Point works gave Bethlehem a seaboard plant long desired for export trade. The whole effect of the purchase was to make Bethlehem the largest producer of steel by 2,500,000 tons of ingot castings and 2,180,000 tons of finished products. The Bethlehem Steel Corporation, with Mr. Schwab as chairman of the board, and Eugene G. Grace as president, is the largest independent. On May 11, Midvale bought the old Diamond State Steel Co., Wilmington, Del., from D. J. Driscoll, Reading, Pa. The Diamond State company's new name was the Wilmington Steel Co. In November, Midvale purchased the Union Coal & Coke Co., Marianna, Pa. Great economies in production have resulted from these combinations. At this writing figures upon which any definite estimate could be based are not available but the earnings for 1916 are certain to be much greater than even those in control expected.

On the Saturday night in February on which the Midvale-Cambria group met in E. T. Stotesbury's residence in Philadelphia to consummate the deal, Mr. Replogle, formerly vice president of Cambria, predicted that his company would earn more than $20,000,000 in 1916. Mr. Corey was more than sceptical.

"What will you bet?" challenged Mr. Replogle.

"A dinner for the group here," replied Mr. Corey.

"You're on. Anything else?"

"Yes—a new hat and a complete outfit, from underclothes out and from shoes up."

"Very well. Is that all?"

"No—$1,000 on top of that."

"You're on," concluded Mr. Replogle

In the party besides Messrs. Stotesbury, Corey and Replogle were Mr. Donner, Arthur E. Newbold and Samuel M. Vauclain.

In October it was admitted all around that Cambria's earnings probably would be more than $30,000,000.

WILLIAM ELLIS COREY

Head of the Midvale Steel & Ordnance Co., who Engineered the Consolidation of the Cambria Steel Co. with the Midvale interests early in February, 1916

It is a paying gamble these days to bet against your own production in the steel business.

Late in November the *Wall Street Journal* estimated that Bethlehem's earnings were at the rate of $7,000,000 a month, or $84,000,000 a year. If Mr. Schwab made any bets against his production nobody has heard him complain of his hard lot as a loser.

Orders on the books of both of the big independents indicate that the coming year will be another record-breaker. White paper and ink are in the same class with steel, when it comes to high prices, and therefore it would be wasteful to offer an estimate or a prediction on just how record-breaking the year 1917 will prove to be. It is doubtful whether, if any one of the major prophets returned to earth and uttered prophesies along this line, he would not be recalled by a farther-sighted Providence.

The mildly exciting custom of comparing figures "with the corresponding period last year" has almost been thrown into the discard; it doesn't mean anything in the steel industry these days, and it probably will mean less before this time next year.

Book Review

Cost Accounting and Burden Application, by Clinton H. Scovell; cloth, 5¼ x 7¼ inches; published by D. Appleton & Co. and furnished by *The Iron Trade Review* for $2, net.

Scientific management is occupying an ever-broadening field in the manufacturing world. This is a hopeful sign for the industrial future and the new science is already having a salutary effect on the present. However, as a science it is still in a state of development and even more efficient systems should be the outgrowth of the present efforts. To determine the relative success of manufacturing methods, a good cost system is of incalculable benefit. This is an additional reason, therefore, why a book on cost accounting and burden application has immense value for the manufacturer. The author in this volume first divides cost into its three elements, material, labor and burden, and then analyzes these in a clear and logical fashion. Six chapters are devoted to a discussion of the elements of expense which make up burden and an explanation of how each should be determined in total, and then analyzed and grouped by productive centers so that a proper burden for each may be known.

Having described in detail the elements of cost, the most effective means of accounting is sought. The budget system is recommended as a means of stopping characteristic leaks, such as wasteful use of supplies and the unnecessary indirect or so-called "non-productive" workers. Also the author emphasizes the importance of cost reports for four-week periods.

Scrap Prices Lag, Then Boom

Supply Greatly Exceeds Demand for Part of the Year—Heavy Cropping of Billets and Ingots to Meet Severe Requirements for Munition Making an Important Factor

BY E. W. ANTENEN

ALTHOUGH during the year, prices of iron and steel scrap as a rule lagged severely behind those of pig iron and finished steel materials, some remarkable new high records were made, especially by the heavy steelmaking and rerolling grades. It is generally conceded the turnover of scrap this year was from 50 to 100 per cent greater than the average of the past five years, but actual statistics to prove this are not available. Consumption, too, has been at a proportionately increased rate due largely to the abnormal demands for iron and steel coming from foreign sources. The export of scrap also has exceeded all previous records.

High prices for a time were the cause of their own decline because they led to an increase of supply. In the last quarter of 1915, prices of scrap rose with rapidity, thus making attractive markets for material which had been accumulating for some years in junk and railroad yards throughout the country. In the spring of 1916, the movement of such accumulations to the large distributing centers came into full swing, thus causing the supply greatly to exceed the demand with the consequence of a general decline in prices in the second and third quarters. The sale of great quantities by railroads in the months before September was a decided factor in lowering the market. Manufacturing operations, notably those in the automobile industry, where drop forging and pressing of steel was the practice, aided to increase the bountiful supply.

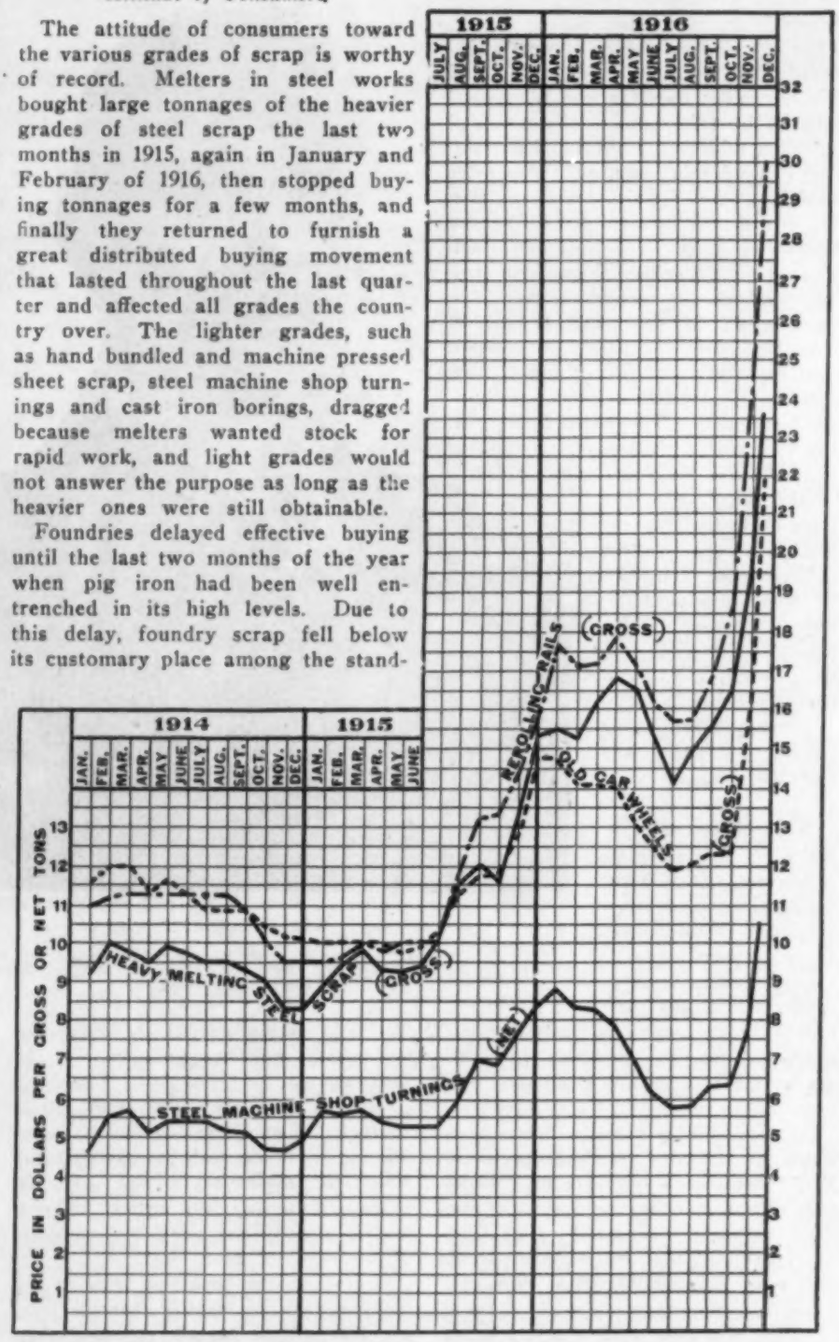
Another factor was the excessive scrapping of croppings of billets and ingots in order to make steel to satisfy rigid specifications of foreign governments for which the steel was being made. Such croppings were remelted in substitution for heavy melting steel scrap that formerly had to be purchased outside the steel works. The duplex process, which is growing in favor as a way of making steel in eastern works, is said to be a cause for a less consumption of scrap. The excess of supply over the demand was manifested to the greatest extent during the late spring and summer months. Compared to soaring prices of finished iron and steel products, scrap seemed hopelessly low. Congestion of unloading facilities at consuming works also emphasized the depression.

Attitude of Consumers

The attitude of consumers toward the various grades of scrap is worthy of record. Melters in steel works bought large tonnages of the heavier grades of steel scrap the last two months in 1915, again in January and February of 1916, then stopped buying tonnages for a few months, and finally they returned to furnish a great distributed buying movement that lasted throughout the last quarter and affected all grades the country over. The lighter grades, such as hand bundled and machine pressed sheet scrap, steel machine shop turnings and cast iron borings, dragged because melters wanted stock for rapid work, and light grades would not answer the purpose as long as the heavier ones were still obtainable.

Foundries delayed effective buying until the last two months of the year when pig iron had been well entrenched in its high levels. Due to this delay, foundry scrap fell below its customary place among the standard grades, only in December showing a decided tendency to regain its lost position.

The movement of shipments also became an interesting study. Nat-


1914
1915
1916
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
PRICE IN DOLLARS PER GROSS OR NET TONS
HEAVY MELTING STEEL SCRAP (GROSS)
STEEL MACHINE SHOP TURNINGS (NET)
REROLLING RAILS (GROSS)
OLD CAR WHEELS (GROSS)

PRICES OF FOUR GRADES OF SCRAP AT CHICAGO, 1914-1916

Strength and Reliability

Hammered by shot and shell—crossing webs of trenches, bursting through strong barricades and without hesitating even—the mighty machine of war comes on. Breakage of a vital part of this machine would place it at the mercy of the foe.

AGATHON STEELS

AGATHON STEELS are specially made for preventing breakage. From the selection of raw material, to the very last of the numerous processes necessary for attaining "AGATHON" quality, we conduct exhaustive tests to make certain that a state of perfection will be reached.

"AGATHON" Chrome Nickel
"AGATHON" Chrome Steel
"AGATHON" Chrome Vanadium
"AGATHON" Nickel Steels
"AGATHON" Special Analyses
"AGATHON" Vanadium
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AGATHON STEELS mean stronger and more durable *Axles, Springs, Connecting Rods, Crank Shafts, Pistons, Cams, Gears,* etc.

Specify "AGATHON" and you will be satisfied.

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urally the prices of scrap first became high in the eastern iron and steel producing districts to which the material was attracted from states bordering on the Gulf of Mexico and those directly northward from there to the Canadian boundary. The center of demand appeared to be at Pittsburgh. Country and railroad scrap then was actively collected and sent eastward.

In the autumn, a decided reversal of conditions came about, the demand in the west becoming much more active and higher than in the east. The change worked gradually from the west to the east. Possibly it was the reduction in the supply of scrap that awakened the westerners, who began to buy it in at a brisk rate. Chicago, St. Louis, Birmingham, Ala., and Cleveland in turn were fired with activity and advancing prices. The change began in September, reached its height in early November, and was finally dissipated with the first half of November, when eastern markets were as active as those in the west. The year ended with prices high and firm throughout the country.

Among the factors that at times influenced scrap prices to move either upward or downward were these: 1. Scarcity of transportation equipment—this reducing the railroad's desire to use such equipment for hauling scrap; 2. labor scarcity—this hindering the collection of railroad scrap and the preparation of sheared grades in private yards, especially during the last half; and, 3—railroad embargoes against shipments to certain consuming points. The railroad embargoes could be traced to a poor sequence of specified deliveries to mills which had bought unprecedented quantities, and it all led to a forced disposal of scrap at concessions in order to avoid large demurrage charges. This was true at various times in all districts in the north and east. Transportation of scrap was disturbed in some degree by the great car shortage in the autumn.

A review would not be complete without a mention of the outstanding features of all market centers. One of these features was the abnormally low prices of steel machine shop turnings, due primarily to an oversupply brought about by the machining of explosive shells made in munition works in America to be used in military work by the warring countries. Here the waste was extraordinarily great. Turnings were not wanted by steel furnace operators because they retarded production of steel there, but their use in blast furnaces steadily increased, although not in sufficient degree to lift the prices materially. Cast iron borings, on the other hand, held comparatively strong and steady throughout the year. These, too, were used to increase melts of blast furnaces.

The export of old iron and steel rails and railroad car axles was in large volume. These, it is believed, were practically all used for direct rerolling in foreign countries. Prices of such old material rose equal to those of semi-finished material of the same weight. Old steel rails fit for re-rolling sold at Chicago at prices above their original cost.

Croppings of billets and ingots in the last quarter of the year also took a huge foreign and domestic demand for re-rolling purposes, this also acting to keep them from being remelted as the practice was earlier in the year.

Heavy melting steel at Cleveland sold at $5 above the previous highest record since 1899 in a one-day's sale, amounting to nearly $1,000,000, made by one Cleveland dealer. Other districts also reported new high records.

Imports of scrap from Canada were impossible due to a Canadian order of embargo until late in November when cast iron borings and steel machine shop turnings again were allowed to cross the border in large volume. No heavy steel was included in such permitted imports.

Teamwork—a Cure for Traffic Ills

(*Continued from page* 17)

the other hand, the increased charge would work some injustice to certain shippers. In the emergency of an acute shortage such as now exists, are the small injustices preferable to the greater injustice of poor car service to all shippers?

Utilize Present Equipment

Shippers and carriers can improve the car service materially by making better use of the present equipment. Open-top cars have been pressed into service largely for hauling sand, gravel, structural steel and other builders' supplies instead of coal. Refrigerator cars have been used instead of common box cars, and have therefore caused a shortage of equipment for western fruit growers.

The Southern Pacific has inaugurated a practice which, if adopted, will enable the better use of the cars now available. Various commodities heretofore shipped only in box cars are loaded on flat or open-top cars and covered with tarpaulins. A bulletin issued by the Southern Pacific Co. shows how open cars, flats and gondolas, have been pressed into service for certain freight, protecting the load with tarpaulins. While this is an experiment with the company, it is not an entirely new proposition, as tarpaulins have been used for this purpose by the railroads in Europe for some time. The tarpaulins are stenciled "Property of the Southern Pacific Co." and numbered consecutively. The auditor of freight accounts has instructed agents at forwarding stations to bill each tarpaulin with $40 advance charges, and agent at destination gets relief by securing the tarpaulin and billing it back to station from which it started. To make this plan of adding to the car supply a success, all station, train and yard men are asked to take a personal interest in the care and handling of these covers, bearing in mind that the tonnage the company is able to move in this manner is just that much more than it could handle otherwise.

Further applications of the same principle are found in the Pacific northwest, where the scarcity of box cars has prompted a Washington lumber concern to transform a number of flat cars into house cars with the regulation roof, running boards, safety appliances, etc. The side posts were set into the stake pockets and the single layer of sheathing was applied on the inside faces of the posts.

The traffic problem is so closely allied with the greater question of railroad regulation, that the final solution will necessarily be worked out in conjunction with the numerous other matters. Every business man should be vitally interested in legislation affecting the railroads, as the federal policy toward the carriers has a direct influence on the transportation service rendered to the iron and steel industry. In the meantime, while the greater problems are being settled, the throttling effect of the car shortage must be borne patiently.

Ability to make the best use of the facilities at hand, is the requisite of immediate relief. Teamwork, extending from the White House to the round-house, is the final solution.

The Bullard Machine Tool Co., Bridgeport, Conn., has taken out a group insurance policy on its 750 employes who are covered for $500 each and upward, a total of about $500,000. The Raybestos Co., also of Bridgeport, has taken a similar policy for its 300 employes, totaling $200,000 of insurance. These were Christmas gifts to the employes of both companies.

New Year Talks with

ROLLING MILL JIM

Well, Fellows, haven't got over the effects of the best Holidays I've ever had yet, but I'll say this much, "keep in close touch with Jim from now on 'cause I'm sure going to give you some real stuff on what to use and how to use it so as to break all records for the good old year 1917."

So long—

Rolling Mill Jim.—

Hubbard Steel Foundry Co.

EAST CHICAGO, IND.

All Kinds of Iron and Steel Rolls and Steel Castings.

Unprecedented Prices for Copper

Form a Striking Feature of the Non-Ferrous Market—One Contract Calls for 25 Per Cent of This Year's Output —Spelter Fluctuates Violently

BY E. C. KREUTZBERG

THE copper market throughout 1916 was inundated periodically by veritable freshets of business, greater in volume than ever before known, and involving requirements beyond the capacity of the industry to produce. The year's record, therefore, was one of unprecedented prices, and of unremitting effort to enlarge the refinery output, so that the country's producing capacity now is the greatest in history. The year opened with the first hand price of electrolytic copper at about 22.50c to 22.75c, delivered, cash in 30 days, with most producers sold ahead two or three months; on small lots, for prompt shipment, the quotation was about 23.12½c, cash New York. The first upward price movement of the year culminated about the middle of February with most producers sold out till June, with 27.50c, usual terms, asked on June, and with small lots of prompt held by second hands at around 29c, cash. The next buying movement, toward the end of April, brought prices to the level of about 28.50c to 29c, usual terms, for July and August shipment, and approximately 30.25c, cash, for small lots of prompt.

Lack of business then resulted in lower prices on second-hand lots, prompt being obtainable about the middle of July at as low as 24.25c to 24.50c, cash. From that time on to the early part of December, buying was of a heavy and fairly sustained character and prices went as high as 35.50c to 35.75c, cash, on prompt shipment in small lots. The close of the year was featured by a dull demand, but with the volume of business on books of sufficient proportions to keep the producers occupied to capacity six to seven months of 1917. The prices last quoted by leading first hands were about 31.50c to 32c, usual terms, for third quarter of 1917 shipment, and 30.50c to 31c, usual terms, for fourth-quarter shipment, and the current bookings include several large tonnages for both of these positions. The figures indicate that high prices will prevail throughout most of 1917. Another year of war probably would create yet higher quotations.

DEMAND during 1916 involved mainly the requirements of the belligerent powers in Europe, and was comprised of large tonnages for export direct to the various countries, and for shipment to domestic brass mills for conversion into brass for the manufacture of war materials. Domestic demand, too, was larger than normal. The largest transaction of the year occurred toward the end of September, when Great Britain contracted for 448,000,000 pounds, to be delivered in 1917; this tonnage alone is expected to account for about 25 per cent of the entire 1917 output. All through the year, high grade lake copper sold at about the same price as electrolytic, while medium quality lake sold at about ¼c to ⅜c less per pound. Demand for lake copper also was in excess of production, but the lake producers were not sold ahead to so great an extent as the electrolytic producers. Casting copper was in good demand throughout the year and by the last quarter bookings had so far outstripped production that most of the makers were booked two or three months ahead.

Early in January, the British government restricted sales of electrolytic and best selected copper in Great Britain to lots of no more than 50 tons, and to a price no higher than £100. At about the same time, speculation on the London metal exchange was prohibited. Throughout the year, however, the usual London metal quotations continued to be cabled here and in all cases these fluctuated well above the £100 limit. Therefore, in view of the fact that these quotations were meaningless as far as they related to the value of the metal, they were construed in some quarters here as having become an instrument in the hands of the British government to influence prices. If this was the intention, however, it met with dubious success. Toward the end of the year, the British government prohibited further purchases and consumption of copper, except by special government permit. This order not only was designed to effect economy by preventing the use of copper for miscellaneous manufacturing purposes, but to insure the advantage as to prices obtainable by concentrating all purchases in the hands of the government.

Many Changes in Tin

The tin market during the year was exceedingly susceptible to price fluctuations, owing to developments in connection with the war. Due to the establishment of 4,000 tons as the figure below which tin stocks in England should not be permitted to remain, it was difficult all through the year to secure licenses for exporting the metal either from the Straits or Great Britain. The British policy in this connection resulted on several occasions in a shortage of tin which, although not becoming acute, caused sensational price developments. This especially was the case in March and April, when spot Straits tin on two separate occasions went up to 55c and the metal in one case was sold as high as 57c. Early in the year, Great Britain announced further exports of tin metal from the Straits to this country, but this policy remained in force only about six weeks and Straits shipments since have been coming through direct. Early in January and in October, the market was affected by submarine operations including the torpedoing of vessels in the far east and off Nantucket. The low price of the year was 37.50c, which was registered on July 19. The high point during the second half of the year was on Oct. 22, when spot Straits sold at 45.75c. Banka tin, due to the fact that this material was cut off from its customary consumption in Germany and Austria, was brought into this country in fair quantities throughout the year. An important development which already has been felt to some extent in its effect upon the world's tin market was the beginning of operations at the new electrolytic tin refinery of the American Smelting & Refining Co., at Perth Amboy, N. J. This plant, which is engaged in the refining of raw material brought from Bolivia, already has capacity for producing more than 600 tons a month and the output in 1917 is expected to average 700 to 800 tons a month.

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Tin, incidentally, is about the only metal which the trade expects to see affected favorably by the conclusion of the European war. This contention has been based on the fact that Germany and Austria are expected to be large purchasers, on the expectation that the English consumption after the war will show a material increase and on the generally accepted opinion that the world's production cannot be increased much above the present rate.

Lead is Consistent

Lead, as usual, was the most consistent performer among the metals during 1916. The prices quoted by the American Smelting & Refining Co. ranged from 5.50c, New York, at the opening of January, to 7.50c, New York. The latter price became effective March 30, and prevailed until June 5. The market then declined to 6c, which was quoted Aug. 2, following which the Smelting company advanced by easy stages until 7.50c again was reached, Dec. 5. The outside market fluctuated between 5.90c and 8.12½c, New York, and at least a few sales were made at the end of March at as high as 8.50c, New York. Railroad embargoes, due to congestion of traffic in the east, caused independent producers early in the year to hold lead at St. Louis at a premium, comparatively, over lead in New York. This was due to the desirability of making export shipments by way of the Pacific coast and the Gulf of Mexico. Heavy export business was placed throughout the year and it is expected that 1916 exports will show a marked increase over the total for 1915.

Spelter Fluctuates

The spelter market during 1916, as usual, was subject to numerous violent fluctuations. The year opened with prime western at 17.12½c, St. Louis, and thereafter prices ascended to 21c, the high point for the year, which was reached Feb. 17. Following a decline to 16c, 19.12½c was reached April 13 and then followed a spasmodic series of fluctuations, which established 8.50c, St. Louis, on Sept. 5, as the low level for the year and on Nov. 29 established 13.12½c as the high point for the second half of the year. The closing weeks of December were characterized by low offers by second hands. Of considerable interest were the shifting premiums asked on the better grades of spelter. For instance, during the first four months, brass special sold at premiums of 2.50c to 3c over the price of prime western. Thereafter the premium declined until in October, brass special commanded only ½c to ¾c more than prime western. An increased demand for brass special in December again raised the premium to 1c. Exports increased in volume as the year progressed and it is expected that the 1916 figures will show a material increase over the exports in 1915. During the early part of the year, London quotations continued to exert considerable sentimental influence on the market here despite the fact that the action of the British government in prohibiting speculation in spelter, as well as all other metals excepting tin, had robbed the London quotations of their value as indicative of the market. Toward the close of the year, the London quotations had lost practically all their influence in determining price movements in this country.

Aluminum Market Strong

The aluminum market reflected a strong tone throughout the year. This was due to the fact that although the domestic production was increased greatly, export shipments were so large as to take up all surplus supplies. The domestic producer followed the method of allowing consumers only such material as they needed to care for their requirements and hence at no time during the year was there an accumulation of material for resale. The domestic producers price for renewing contracts with regular customers into 1917 was 35c. The year opened with No. 1 virgin aluminum obtainable for prompt shipment in the outside market at around 57c. Following downward fluctuations, the price increased to 62c on Feb. 29 and following another decline, 65.50c was reached on June 19. This was the high price of the year. For a short time in December, 65c again prevailed, but prices late in the year gave evidence of a tendency to become somewhat easier.

Antimony Maintains Even Tone

Demand for antimony, with the exception of the first three or four months, did not reach the sensational proportions of 1915. This was due to the decreasing shrapnel requirements of the belligerent European powers. The market opened in January at 40.50c, and on March 22 reached the high point of 45c. The low point of the year, was 10.50c, which was done Aug. 11. During the remainder of the year prices fluctuated between 11c and 15c. About the middle of the year, the Chinese and Japanese production was greatly increased, and low prices made operations at all but one smelter in this country unprofitable.

The Causes of Industrial Discord

In his address to the American Mining Congress, which met in Chicago in November, Col. George Pope, president of the National Association of Manufacturers, spoke about some of the flaws in our modern industrial and economical fibre. "Inefficiency, poor wages, poor living conditions, lawlessness, strike disorder and industrial discord," he said, "are the proof of either the failure or the absence of intelligent and scientific cooperation." He believes that the average business man has been too actively concerned with the extension of his private affairs and has too readily banished from his mind the obligations he and his industry owe to the common good. Cooperation, he maintains, is not only constructive, but also is corrective.

Another important factor in the strengthening of this economical fibre to eliminate the unrest of labor and to promote efficient production is industrial conservation. The propaganda for this desiratum should be carried on irrespective of politics and should be non-sectional and non-partisan. The underlying principles of this movement are just as important in their effect upon merchants and bankers as they are upon the manufacturer —in fact, industrial conservation should demand the attention of all persons constituting a community life.

Co-operation is the Keystone

Col. Pope believes that the fulfillment of the industrial destiny of America is calm and undisturbed so long as we continually build for this future. Our enormous industrial, agricultural, mining and transportation investments and the welfare of the 30,000,000 workers in this gigantic commonwealth of enterprise must be guarded by a self-controlled, democratic form of government in order that the highest type citizenship be maintained and that our liberities of thought and action be preserved.

"Cooperation, therefore," he states, "is the goal we should strive to reach. Not merely cooperation among the members of an individual industry, but among all industrial and commercial organizations, for, in the last analysis their interests are mutual. These interests are not merely for the benefitting of immediate interests of the employers, but extend to the interest of the employes, for each is dependent upon the other for efficiency, better wages, improved living conditions and industrial freedom, and these conditions being obtained, we have, I believe, the best protection against strikes and lawlessness."

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1916 Tool Buying Smashes Records

Foreign Orders Swell the Year's Total But Domestic Business Outdistances the Most Optimistic Predictions—Price Advances Were Frequent—Ship Builders, Munition Plants and Railroads Besiege Manufacturers

UNIQUE and record-breaking in many respects, 1916 in the machine tool market was featured by a volume of sales fully equal to the unprecedented bookings of 1915. Nineteen sixteen was the first year that the machine tool industry ever began in full prosperity, which was also completed in full prosperity. Business on the books both at the beginning and end of the year was of sufficient proportions to keep the entire industry occupied to capacity for several months. At least one month, November, probably represented the largest total of business ever placed in a like period. The year shattered all records for the amount of business placed for purely peaceful purposes. The most sensational bookings during 1915 came from the belligerent European countries, and from concerns in the United States who were getting ready to manufacture munitions, the bulk of the 1916 business reflected the never ending requirements of expansion in all lines of domestic industry. A great deal of this expansion, of course, such as that in the ship building, mining and smelting and iron and steel industries, and in machine shops throughout the country, resulted from opportunities created by the war, but the improvements and enlargements which were made were of a permanent character, enabling the country as a whole to manufacture on a larger scale than ever before. To the same extent as their products increased the capacity of other lines of industry, the output of the machine tool plants themselves have been augmented, until now the capacity to produce tools is greater by far than ever before in the history of tool building in the United States.

LOOKING to the future, the principal factor in determining the course of the market in 1917, naturally, is the duration of the war. The generally accepted belief is that the ending of the war will be accomplished by a termination of most of the opportunities for industrial expansion which made possible the tremendous volume of machine tool business in 1916. What will happen following the re-establishment of peace is something that manufacturers generally do not care to think about. As long as the war continues, however, it is considered safe to prophesy that a demand for all kinds of machinery will continue of heavy and sustained proportions. Some authorities believe that under no circumstances can 1917 be as satisfactory as 1916, due to the fact that the tendency in the development of the opportunities for expansion constantly is toward the maximum. The steady buying is, therefore, bringing the market nearer to the "limit of saturation".

However, 1917 is ushered in under exceedingly favorable circumstances as far as the portion of the 1917 output already sold is concerned. Shapers are sold up five to six months ahead. Planers are scarce in all sizes; the demand has been chiefly for sizes larger than 33 inches, so that the production of smaller sizes has been curtailed. It is difficult to secure planers, particularly in the larger sizes, for delivery before six months. Universal grinders are scarce, being sold up to May and June, and automatic tools of various kinds are sold five or six months ahead. Plain and universal milling machines are sold up to July. Although there are plenty of single-purpose lathes available, the standard makes of lathes are pretty well sold up in the small sizes, and 14, 16 and 18-inch lathes cannot be had in quantities before July. On other tools the market is less well sold ahead. Demand for turret lathes has fallen off and these machines now can be bought for immediate or nearby shipment. Deliveries can be had in three to five months on 20-inch and larger lathes. Radial drills are sold ahead till March or April. High-speed drills can be had for delivery within two or three months and upright drills in about six weeks to two months. Hand screw machines can be had for comparatively early delivery and cold saws are easier to get than at the beginning of the year. These statements apply to the industry as a whole, some makers, of course, being in a better position than others as to deliveries. In general, it may be stated, the machine tool market is sold up for the first six months of 1917.

Domestic Buyers Pound Builders

Domestic demand, not related to the war, came from practically all lines of industry. Large contributions toward the total came from the ship building, iron and steel, mining, automobile, automobile accessory, aeroplane, machine tool, agricultural implement, railway and railway equipment, special machinery and other industries. Buying of equipment by American concerns engaged in the manufacture of war munitions, formed an exceedingly large total. The largest buyer of this character probably was the Bethlehem Steel Co., while the American Locomotive Co. and the Midvale Steel & Ordnance Co. were not far behind. The purchases of these concerns alone aggregated several million dollars and large requirements also were bought by many other concerns. A large portion of this business was comprised in large-swing lathes for making 9.2-inch and 12-inch shells; a large portion also embraced time fuse-making equipment. The contribution by the munitionmakers to the volume of machine tool business tended to form a smaller percentage of the total as the year progressed.

Foreign buying, which accounted for 50 to 75 per cent of the bookings of 1915, fell off in 1916 to about 10 to 25 per cent of the total. The heaviest export buyer was Russia, and that country took a wide variety of equipment. Good bookings came from England and France, and a particularly large number of heavy lathes for making 9.2-inch and 12-inch shells were sold. Italy was a fairly active buyer. A small proportion of the total export sales was distributed among such neutral destinations as Portugal, Spain, the Argentine, Chile, Cuba, the Hawaiian islands, Norway, Sweden and Denmark. One especially notable order included a complete shop equipment for the Chilean state railways.

Prices on machine tools were moved upward in February and thereafter remained stationary till July. In that month and at intervals through the remainder of the year, the various builders declared fresh advances. At the end of the year prices on standard makes of lathes and some other tools were 60 to 75 per cent higher than they were two years ago and prices

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on machine tools generally were 40 to 75 per cent higher, with the exception of some special railroad tools, which were not advanced in proportion with the rest of the market. Prices on nearly all heavy equipment were advanced radically. For instance, quotations on cranes ranged from 75 to 200 per cent higher than two years ago. Practically the only exception to this general upward tendency occurred in connection with the prices on second-hand tools. These quotations in July were lowered by about 25 to 30 per cent, due to the sudden broadening of the supply of second-hand machinery, and the level thus established was maintained the remainder of the year.

A review of the year's developments would not be complete without mention of the labor troubles which in the spring and summer broke out in practically all the manufacturing centers, seriously interfering with and curtailing the output of machine tools. Strikes were called at plants in New England, in northern New Jersey and in the Cincinnati, Pittsburgh and other districts. In practically all cases these were settled by the willingness of the employers to grant increased compensation; the 8-hour day was conceded by comparatively few concerns. All through the year, there was a shortage of skilled workmen, although this was less marked toward the close of the year.

Forming a New Lukens Company

Application has been made to the state of Pennsylvania for the chartering of the Lukens Steel Co., as the successor to the Lukens Iron & Steel Co., Coatesville. This action provides for a recapitalization of the company to cover equities which have been accumulated since its formation. It involves no change in the present management or organization. Some new outside capital, however, which it is understood will be furnished by prominent Philadelphia bankers, is going into the business. No new extensions of capacity are contemplated.

The Lukens Iron & Steel Co. is a closed corporation and has a nominal capitalization of $500,000, the same as at the time of organization. The capitalization of the new Lukens Steel Co. is to be $6,000,000 of 7 per cent cumulative first preferred, $6,000,000 of 7 per cent cumulative convertible second preferred and $10,500,000 common. Henry & West, Philadelphia, and White, Weed & Co., New York, will offer a portion of the first preferred to the public.

Melting With Electricity

The Electric Furnace, After a Comparatively Slow Development, is Being Adapted to Varied Uses

BY W. MAC A. JOHNSON

THE electric furnace today has a prospect for increasing economic usefulness and this usefulness will be enhanced by the clearness of outlook of electrical, metallurgical and chemical engineers over the prospective field. The industrial development of the electric furnace has been comparatively slight and slow. In general, we may say that the cause of this is that in the past the cost of power has been so great that the cost of electrically-generated heat units has been much higher than that of the fuel-generated heat units. We find today that even in Norway, where electrical power costs only $5 per horsepower year, electrical heat at the same efficiency of application is more expensive than the heat generated by anthracite coal at $8.00 per ton. Let us take power at $0.01 per kilowatt hour. This compared with soft coal at $2.00 per ton costs some 35 times that of the fuel-generated heat. When we consider that even at the present time, $0.01 per kilowatt hour is rather a low cost for power and that $2.00 per ton for coal is high for such centers as Pittsburgh, we gain a clear idea of the prime disadvantage of heating by electrical energy. Some features of the electric furnace, however, make the cost of operation less prohibitive. The neatness and efficiency of the electric furnace methods when their use is understood, quality combined with quantity which meets the present-day demands of society and increased production with a decreased expenditure for labor are some of the advantages.

The application of these features may be illustrated in the adoption of the electric furnace in the non-ferrous foundry. This industry has made great strides in many directions but not in the melting of copper and spelter to make yellow metal. The effect of the heat on the melters is one of the greatest disadvantages presented by melting in crucibles. Persons who have been around a brass furnace during hot weather and have compared its operation with that of the future electric brass furnace with cold walls, using 70 per cent of the heat, and with, let us imagine, a set of molds on a transportation device moving before the furnace as the metal is poured, readily appreciate some of the advantages of the electric furnace.

In the electric brass furnace, the heat is put inside the furnace exactly where it is needed, whereas in the crucible furnace, the heat must flow through the walls which are comparatively poor conductors of heat. In such an electric furnace, the metal losses could be reduced to a minimum. The repairs on an electric furnace could be made fairly small and the operation of such a furnace would eliminate the cost of the crucibles.

In addition to these advantages, there is another, and that is the removal of oxide and dross by "dead killing" in the neutral atmosphere of the electric furnace. Sluggish molten metal and weak and imperfect castings are caused by included oxides, so far as can be observed, more than by anything else, providing the molding is completely done. Quality can be attained easily in the electric brass furnace and the oxide floated to the top, even if the raw materials are not chemically pure.

Exceptionally good steel may also be made in an electric furnace at a cost approximating the present one. The steel is in the electric furnace for only an hour or so. A slag, which is very high in lime content, is kept liquid with the powerful electric arc. This kind of slag makes a very powerful purifier. The reaction between the dissolved carbide of iron and the dissolved oxide of iron is brought to a finality in the neutral atmosphere of the electric furnace at the high final temperature. This permits of the steel being poured quietly and thus makes a homogeneous ingot. Another attractive phase of the development of the electric steel furnace is its ability to melt down steel scrap to make small steel castings and to produce alloy steels. The electric furnace, in this case is able to compete with the small side-blown bessemer converter because the converter requires a charge of high-grade pig iron while the electric furnace may use borings or turnings which usually sell at a discount in the scrap market. Such scrap is particularly plentiful at the present time due to the large number of manufacturing plants which are engaged in making munitions.

A resume of a paper presented before the Cleveland section of the American Institute of Electrical Engineers. The author is a metallurgical engineer, New York.

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Average Monthly Prices of Iron and Steel Products

At Pittsburgh, Chicago and in the East, 1916

Finished Products in Net Tons. Pig Iron and Billets in Gross Tons

Average Monthly Prices at Pittsburgh in 1916

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Pig Iron:—												
Bessemer	$21.32	$21.45	$21.55	$21.95	$21.95	$21.95	$21.95	$21.95	$22.20	$24.325	$30.35	$35.95
Basic	19.20	18.77	19.20	19.20	18.95	18.95	18.95	18.95	19.075	20.825	25.95	30.95
Foundry No. 2	19.95	19.51	19.45	19.45	19.325	19.45	19.45	19.45	19.50	21.075	26.76	31.70
Malleable	19.95	19.60	19.45	19.45	19.45	19.45	19.45	19.45	19.50	21.075	26.76	31.70
Gray forge	19.20	18.95	18.75	18.95	18.95	18.95	18.95	18.95	19.00	20.1375	25.95	30.60
Ferro-Alloys:—												
Ferro-mang., Balti	121.00	137.00	170.00	175.00	175.00	175.00	175.00	170.00	172.50	163.00	161.40	160.00
Ferro-sil. (50 per cent)	83.00	83.00	83.00	83.00	83.00	83.00	83.00	83.00	83.00	94.25	95.00	95.00
Ferro-sil. (10 per cent)	28.00	28.00	31.00	31.00	32.00	32.00	32.00	31.80	30.25	30.50	34.60	42.00
Semi-Finished:—												
Bess. billets	33.75	34.00	40.60	45.00	44.25	41.20	40.00	43.60	45.00	45.75	52.00	59.00
O. H. billets	34.75	35.00	40.60	45.00	44.25	41.20	40.00	43.60	45.00	45.75	52.00	59.00
Bessemer sheet bars	33.75	34.00	41.00	45.00	44.25	41.20	40.00	43.60	45.00	45.75	52.00	59.00
O. H. sheet bars	34.75	35.00	41.00	45.00	44.25	41.20	40.00	43.60	45.00	45.75	52.00	59.00
Wire rods	46.25	50.00	51.00	55.00	60.00	60.00	58.75	55.00	55.00	55.00	64.00	69.00
Coke:—												
Spot furnace coke	3.06	3.25	3.55	2.37	2.1875	2.44	2.64	2.71	2.875	4.875	6.95	7.50
Contract furnace	2.38	2.50	2.80	2.98	2.60	2.63	2.42	2.40	2.4875	3.375	3.75	4.25
Spot foundry coke	3.75	3.75	3.60	3.87	3.125	3.00	3.00	3.05	3.25	4.375	8.60	9.25
Contract foundry	3.00	3.75	3.90	3.50	3.50	3.50	3.15	3.15	3.175	4.875	5.50	6.00
Finished Products:—												
Bessemer steel rails	28.00	28.00	28.00	30.46	31.76	33.00	33.00	33.00	33.00	33.00	35.00	38.00
Beams	1.86c	2.03c	2.40c	2.50c	2.50c	2.50c	2.50c	2.50c	2.60c	2.70c	2.88c	3.00c
Plates	1.87c	2.13c	2.50c	2.67c	2.75c	2.75c	2.86c	2.90c	2.95c	3.00c	3.35c	3.50c
Steel bars	1.86c	2.01c	2.34c	2.50c	2.50c	2.50c	2.50c	2.50c	2.60c	2.60c	2.78c	2.90c
Iron bars	2.05c	2.20c	2.40c	2.50c	2.65c	2.65c	2.65c	2.65c	2.65c	2.65c	2.75c	3.25c
Shafting, discount	44.00	40.00	27.00	15.00	10.00	10.00	12.05	15.00	15.00	10.00	10.00	10.00
Steel pipe, ¾ to 3 in.	76.75	68.00	73.6	71.5	70.00	70.00	70.00	70.00	69.25	69.00	68.6	66.00
Standard spikes	2.175c	2.27c	2.50c	2.65c	2.65c	2.65c	2.65c	2.65c	2.65c	2.65c	2.65c	3.25c
Wire nails	$2.125	$2.22	$2.38	$2.40	$2.50	$2.50	$2.50	$2.58	$2.60	$2.625	$2.85	$3.00
Plain wire	1.975	2.10	2.23	2.25	2.45	2.45	2.45	2.53	2.55	2.575	2.80	2.95
Hoops	2.00c	2.25c	2.55c	2.75c	2.75c	2.75c	2.75c	2.85c	3.00c	3.00c	3.25c	3.25c
Bands	1.865c	2.03c	2.34c	2.50c	2.50c	2.50c	2.50c	2.58c	2.60c	2.60c	2.74c	2.90c
Struct. rivets	2.575c	2.77c	3.11c	3.37c	3.875c	4.25c	4.06c	4.00c	4.00c	4.00c	4.08c	4.25c
Sheets and Tin Plate:—												
No. 28 black sheets	2.58c	2.60c	2.75c	2.90c	2.925c	2.92c	2.90c	2.75c	2.8875	3.225c	3.67c	4.45c
No. 28 galv. sheets	4.75c	4.75c	4.82c	4.89c	4.8875c	4.79c	4.375c	4.25c	4.225c	4.45c	5.07c	6.25c
No. 10 blue anld.	2.45c	2.61c	2.87c	3.00c	3.025c	3.10c	3.00c	3.00c	2.925c	3.125c	3.30c	3.90c
Tin plate	$3.75	$3.75	$4.15	$4.69	$5.125	$5.55	$5.81	$6.00	$5.625	$5.75	$6.05	$6.50
Old Material:—												
Heavy melting	17.50	17.37	17.95	18.12	17.125	16.25	16.25	16.00	16.125	17.875	20.55	26.75

Average Monthly Prices of Raw and Finished Materials in the East in 1916

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Pig Iron:—												
Basic pig iron, eastern Pa.	$19.50	$19.50	$20.00	$20.50	$20.00	$19.25	$19.00	$19.25	$20.00	$21.00	$25.50	$30.50
No. 2X fdy., Philadelphia	19.75	20.00	20.00	20.75	20.50	19.75	19.75	19.75	19.75	20.50	25.25	30.25
No. 2X, Virginia furnace	17.25	18.00	18.25	18.50	18.50	18.50	18.50	18.50	17.50	18.50	23.75	27.00
Stand. low phos., Phila.	32.00	32.00	32.00	33.00	34.00	34.00	33.00	33.00	34.00	40.00	46.00	55.00
Stand. gray forge, east. Pa.	18.50	18.50	18.75	19.25	19.50	19.25	18.50	18.25	18.50	19.25	23.50	28.50
Rolled Products:—												
Tank plates, base Phila.	2.409c	2.659c	3.409c	3.809c	3.909c	3.909c	3.909c	3.909c	3.909c	3.909c	4.159c	4.409c
Struc. shapes, base Phila.	2.159c	2.209c	2.459c	2.659c	2.659c	2.659c	2.659c	2.659c	2.759c	2.859c	3.109c	3.409c
Steel bars, base Phila.	2.009c	2.259c	2.509c	2.650c	2.659c	2.659c	2.659c	2.659c	2.759c	2.809c	3.009c	3.109c
Com. iron bars, base Phila.	2.259c	2.259c	2.259c	2.559c	2.559c	2.559c	2.559c	2.559c	2.659c	2.659c	2.659c	3.059c
Open hearth billets, Phila.	40.00	40.00	44.00	45.00	50.00	50.00	45.00	45.00	47.50	50.00	52.50	57.50
Old Material:—												
No. 1 hvy. melt. st'l, E. Pa.	16.75	16.50	17.50	17.75	16.75	15.50	15.00	15.00	15.00	15.75	19.50	24.00
No. 1 R. R. wgt., E. Pa.	22.25	22.50	23.00	23.00	22.50	20.00	19.75	20.00	21.00	22.00	24.00	28.00
No. 1 heavy cast, E. Pa.	17.50	17.50	17.75	18.00	17.75	16.50	16.00	16.00	16.25	16.50	18.50	22.00

Average Monthly Prices, Chicago District, 1916

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Pig Iron:—												
Lake Superior charcoal	$19.25	$19.50	$19.75	$19.75	$19.75	$19.75	$19.75	$19.75	$19.75	$20.35	$21.95	$31.78
Northern No. 2 foundry	18.50	18.50	18.70	19.00	19.00	19.00	19.00	19.00	18.65	19.15	25.00	30.00
Southern No. 2 foundry	19.00	19.00	19.30	19.50	19.50	19.50	18.00	18.00	18.00	18.50	23.50	26.00
Rolled Products:—												
Bar iron	1.83	1.91	2.19	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.52	2.60
Steel bars	2.05	2.25	2.50	2.65	2.70	2.70	2.70	2.80	2.80	2.80	2.90	3.09
Structurals	2.05	2.25	2.50	2.65	2.70	2.70	2.70	2.80	2.80	2.80	3.03	3.19
Plates	2.05	2.35	2.75	2.95	3.10	3.10	3.10	3.15	3.20	3.20	3.46	3.69
Sheets No. 28 black	2.80	2.85	3.00	3.10	3.10	3.10	3.10	3.10	3.15	3.35	3.99	4.19
Old Material:—												
No. 1 R. R. wrought	15.50	14.95	16.15	16.80	16.35	15.35	13.95	15.40	16.65	17.50	21.25	26.00
Heavy melting steel	15.50	15.25	16.20	16.75	16.50	15.35	14.10	14.90	15.50	16.50	19.35	24.00
Rerolling rails	17.70	17.15	17.20	17.90	17.25	16.25	15.70	15.70	16.85	18.75	24.90	31.00
Car wheels	14.75	14.05	14.05	14.00	13.15	12.50	11.90	12.00	12.25	12.25	15.95	21.00
Steel car axles	22.15	22.25	24.00	26.00	26.00	25.25	26.90	28.50	31.15	34.40	37.50	42.00

"WHEELING"
Standard Bessemer Steel Pipe

EASY TO CUT AND THREAD

Saves the Practical Plumber and Steamfitter

TIME, TROUBLE AND MONEY

IT IS A

"DEAD SOFT"

PROPOSITION

BACKED BY QUALITY

Which We Control at Every Stage of Manufacture in Our Own Mills

From the Ore to the Finished Product

"THAT'S THE REASON"

Tubing, Casing, Line Pipe, Drive Pipe

FOR OIL AND GAS WELLS

"WHEELING"

Highest Grade

Bright Coke Tin Plate

Made in the Most Modern Plant in the World

Annual Capacity

TWO MILLION BASE BOXES

Discriminating Consumers are Our Best Customers

WHEELING STEEL & IRON COMPANY

WHEELING, W. VA.

Average Monthly Prices of Iron and Steel Products, 1905-1916

Finished Products in Net Tons. Pig Iron and Billets in Gross Tons

1916

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$18.50	18.50	18.70	19.00	19.00	19.00	19.00	19.00	18.65	19.15	25.00	30.00
Gray Forge Cincinnati	$16.40	16.53	16.90	16.90	16.90	16.35	15.90	15.50	16.40	17.03	21.50	24.90
Plates Chicago	$41.00	47.00	55.00	59.00	62.00	62.00	62.00	63.00	64.00	64.00	69.20	73.80
Billets (Bess.) Pittsburgh	$33.75	34.00	40.60	45.00	44.25	41.20	40.00	43.60	45.00	45.75	52.00	59.00
Bessemer Pig Pittsburgh	$21.32	21.45	21.55	21.95	21.95	21.95	21.95	21.95	22.20	24.33	30.35	35.95
Basic Pig Pittsburgh	$19.20	18.77	19.20	19.20	18.95	18.95	18.95	18.95	19.08	20.83	25.95	30.95
Beams Pittsburgh	$37.20	40.60	48.00	50.00	50.00	50.00	50.00	50.00	50.00	52.00	54.00	57.60
Bar Iron Cleveland	$40.00	45.80	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	51.00	54.00
Steel Bars Pittsburgh	$37.20	40.20	46.80	50.00	50.00	50.00	50.00	50.00	50.00	52.00	52.00	55.60
No. 2 Foundry Birmingham	$14.50	14.63	15.00	15.00	15.00	14.45	14.00	13.60	14.38	15.13	19.60	24.00

1915

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.38	13.80	14.44	17.12	18.00
Gray Forge Cincinnati	$11.40	11.40	11.28	11.25	11.65	11.46	11.50	12.90	13.20	13.65	15.03	16.20
Plates Chicago	$25.60	25.40	26.80	25.60	25.80	26.20	27.80	28.80	29.80	31.10	35.80	39.40
Billets (Bess.) Pittsburgh	$19.50	19.50	19.50	19.50	19.50	19.87	21.40	23.00	24.60	25.50	27.75	29.50
Bessemer Pig Pittsburgh	$14.70	14.63	14.55	14.55	14.55	14.58	14.88	15.89	16.80	16.95	17.45	19.85
Basic Pig Pittsburgh	$13.42	14.09	13.96	13.90	13.90	13.90	13.90	13.90	13.90	13.75	13.45	13.45
Beams Pittsburgh	$22.00	22.00	23.00	23.00	24.00	24.00	25.00	26.00	26.80	28.10	32.50	36.00
Bar Iron Cleveland	$23.00	23.00	24.00	24.40	24.00	24.00	24.00	24.50	26.20	27.75	30.00	35.00
Steel Bars Pittsburgh	$22.00	22.00	23.00	24.00	24.00	24.00	25.00	26.00	26.80	28.20	32.50	34.80
No. 2 Foundry Birmingham	$ 9.50	9.50	9.38	9.35	9.75	9.56	9.60	11.00	11.30	11.75	13.12	14.20

1914

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$14.25	14.19	14.25	14.25	14.25	14.19	14.00	14.00	13.63	13.30	13.00	13.00
Gray Forge Cincinnati	$12.75	12.75	12.87	12.75	12.75	12.69	12.30	12.25	12.25	12.25	11.90	11.40
Plates Chicago	$26.60	27.35	27.60	26.36	25.80	25.60	25.60	27.35	27.35	26.04	25.00	24.00
Billets (Bess.) Pittsburgh	$20.00	20.75	21.00	20.80	20.00	19.75	19.30	20.00	21.00	20.60	19.00	18.50
Bessemer Pig Pittsburgh	$15.00	15.09	15.15	15.14	14.90	14.90	14.90	14.90	14.90	14.85	14.70	14.70
Beams Pittsburgh	$24.00	24.00	24.00	23.60	23.00	22.38	22.20	23.50	24.00	23.50	22.20	21.00
Bar Iron Cleveland	$26.00	26.00	24.75	24.60	24.00	24.00	24.00	24.00	24.00	24.00	23.75	23.00
No. 2 Foundry Birmingham	$10.50	10.50	10.60	10.50	10.50	10.44	10.05	10.00	10.00	10.00	9.88	9.50

1913

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$18.00	18.00	17.62	17.25	16.70	16.12	15.20	15.00	15.00	15.00	15.00	14.50
Gray Forge Cincinnati	$15.75	15.25	15.25	14.25	13.50	12.75	12.75	12.75	13.25	13.25	13.00	13.25
Plates Chicago	$33.60	33.60	33.60	33.60	32.80	32.60	32.60	32.60	31.60	30.80	28.85	27.60
Billets (Bess.) Pittsburgh	$28.20	28.87	29.00	29.00	27.37	26.50	26.50	26.12	25.00	23.00	20.87	20.00
Bessemer Pig Pittsburgh	$18.15	18.15	18.15	17.92	17.90	17.26	16.65	16.52	16.65	16.60	16.09	15.90
Beams Pittsburgh	$29.00	29.00	29.00	29.00	29.00	29.00	29.00	29.00	28.25	27.40	26.00	25.00
Bar Iron Cleveland	$33.00	33.00	33.00	33.00	32.50	32.00	31.20	29.25	28.25	27.40	27.00	26.00
No. 2 Foundry Birmingham	$13.70	13.50	13.00	12.50	11.75	10.60	10.50	11.00	11.00	11.00	10.75	11.00

1912

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$14.00	14.00	14.00	14.25	14.50	14.50	14.62	15.30	16.37	17.30	17.87	18.00
Gray Forge Cincinnati	$12.50	12.50	12.50	12.50	12.85	13.00	13.50	13.90	14.75	15.70	16.18	15.75
Plates Chicago	$26.00	25.76	25.90	27.55	28.60	28.60	29.60	30.40	31.35	32.60	33.60	33.60
Billets (Bess.) Pittsburgh	$20.00	20.00	19.88	20.00	21.10	21.88	22.25	22.40	23.75	25.70	26.75	27.00
Bessemer Pig Pittsburgh	$15.15	15.00	15.02	15.15	15.15	15.15	15.15	15.15	15.43	15.93	17.75	18.05	18.15
Beams Pittsburgh	$23.00	23.00	23.00	23.40	25.00	25.00	26.00	27.40	28.60	28.60	29.00	29.00	29.00
Bar Iron Cleveland	$24.00	23.50	23.50	24.00	24.00	24.40	25.25	27.00	27.25	29.00	30.20	31.00	31.00
No. 2 Foundry Birmingham	$10.00	10.00	10.06	10.50	10.95	11.00	11.25	11.65	12.50	13.45	13.75	13.50

1911

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	14.50	14.50	14.50	14.00	14.00
Gray Forge Cincinnati	$13.35	13.25	13.15	13.05	12.90	12.50	12.05	12.05	12.05	12.00	12.00	12.00
Plates Chicago	$31.60	31.60	31.60	30.60	30.60	30.60	30.60	30.60	29.60	29.60	26.60	25.00	25.00
Billets (Bess.) Pittsburgh	$23.00	23.00	23.00	23.00	23.00	21.00	21.00	21.00	21.00	20.00	19.70	19.25
Bessemer Pig Pittsburgh	$15.90	15.90	15.90	15.90	15.90	15.90	15.90	15.90	15.90	15.39	15.10	15.15
Beams Pittsburgh	$28.00	28.00	28.00	28.00	28.00	27.00	27.00	27.00	26.40	24.00	23.60	23.25
Bar Iron Cleveland	$27.00	27.00	27.00	26.75	26.20	24.75	24.00	25.00	24.75	24.00	24.00	24.00
No. 2 Foundry Birmingham	$11.00	11.00	11.00	11.00	10.75	10.25	10.00	10.05	10.10	10.00	9.75	10.00

1910

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$19.00	18.75	18.25	17.00	16.75	16.50	16.50	16.50	16.50	16.00	16.00	16.00
Gray Forge Cincinnati	$16.50	16.38	15.75	14.88	14.56	14.35	14.12	13.75	13.75	13.75	13.75	13.75
Plates Chicago	$35.60	35.60	34.60	33.60	33.60	32.60	31.60	31.60	31.60	31.60	30.60	30.60
Billets (Bess.) Pittsburgh	$27.87	27.50	27.50	27.00	26.12	25.50	25.00	25.00	24.50	23.38	23.00	23.00
Bessemer Pig Pittsburgh	$19.90	19.42	18.90	18.15	17.09	16.73	16.40	16.21	15.90	15.90	15.90	15.90
Beams Pittsburgh	$31.00	31.00	30.40	30.00	30.00	29.20	28.20	28.00	28.00	28.00	28.00	28.00
Bar Iron Cleveland	$33.00	33.00	33.00	32.50	31.00	30.10	28.00	28.00	28.00	27.80	27.00
No. 2 Foundry Birmingham	$14.00	13.88	13.00	12.12	11.81	11.60	11.38	11.00	11.00	11.00	11.00	11.00

1909

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$17.44	16.75	16.50	16.46	16.21	16.41	16.90	17.37	18.20	18.87	19.00	19.00
Gray Forge Cincinnati	$14.75	14.62	13.50	13.25	13.31	13.50	13.95	14.62	15.25	15.62	16.75	16.75
Plates Chicago	$35.60	34.10	29.60	28.60	28.95	28.60	30.60	31.60	32.80	33.60	35.60	35.60
Billets (Bess.) Pittsburgh	$25.00	23.50	23.00	22.00	22.50	23.00	24.00	25.00	26.00	26.50	27.50	27.50
Bessemer Pig Pittsburgh	$17.34	16.78	16.34	15.80	15.48	16.13	16.37	17.13	18.33	19.68	19.90	19.90
Beams Pittsburgh	$32.00	29.00	26.00	24.00	25.00	26.00	27.00	28.00	30.00	30.00	31.00	32.00
Bar Iron Cleveland	$29.00	28.75	26.20	25.25	25.00	26.20	29.25	30.00	30.00	30.00	32.00	32.00
No. 2 Foundry Birmingham	$13.00	12.70	11.75	11.00	11.00	11.21	12.30	13.00	14.00	14.50	14.50	14.00

1908

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$18.24	17.87	17.42	17.21	17.00	17.31	17.00	17.00	16.75	16.50	16.75	17.35
Gray Forge Cincinnati	$14.45	14.06	13.63	13.60	13.50	13.75	13.70	14.00	14.25	14.25	14.25	14.75
Plates Chicago	$37.60	37.60	37.60	37.60	36.60	35.60	35.60	35.60	35.60	35.60	35.60	35.60
Billets (Bess.) Pittsburgh	$28.00	28.00	28.00	28.00	28.00	26.50	25.00	25.00	25.00	25.00	25.00	25.00
Bessemer Pig Pittsburgh	$19.00	17.90	17.86	17.49	16.92	16.90	16.73	16.11	15.90	15.48	16.74	17.40
Beams Pittsburgh	$34.00	34.00	34.00	34.00	34.00	33.00	32.00	32.00	32.00	32.00	32.00	32.00
Bar Iron Cleveland	$28.80	27.00	28.00	28.00	30.00	29.00	29.00	29.00	29.00	29.00	29.00	29.00
No. 2 Foundry Birmingham	$12.80	12.50	12.12	11.90	11.50	12.00	11.60	12.06	12.50	12.50	12.50	13.00

1907

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$26.00	26.50	26.75	27.50	27.40	26.50	25.40	24.50	23.60	22.60	20.60	19.00
Gray Forge Cincinnati	$22.60	22.50	22.70	21.50	21.90	21.35	20.55	19.95	18.85	18.45	17.35	15.50
Plates Chicago	$35.30	37.30	37.30	37.30	39.40	39.60	39.60	39.60	36.60	37.60	37.60	37.60
Billets (Bess.) Pittsburgh	$29.75	29.50	29.25	29.75	30.25	31.00	30.00	30.00	29.50	28.50	28.00	28.00
Bessemer Pig Pittsburgh	$22.92	22.78	22.85	22.16	24.10	24.10	23.30	22.90	22.90	23.80	20.60	19.90
Beams Pittsburgh	$34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
Bar Iron Cleveland	$39.00	36.50	36.00	36.00	35.00	34.00	34.00	33.00	33.00	32.50	31.00	31.00
No. 2 Foundry Birmingham	$23.00	23.00	22.75	22.00	21.40	21.25	20.50	19.80	18.12	17.65	16.00	14.91

1906

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$19.25	19.25	19.00	18.75	18.50	18.10	18.30	18.90	19.75	21.50	26.50	27.00
Gray Forge Cincinnati	$15.75	15.05	14.85	14.75	14.75	14.65	14.55	15.40	16.50	17.50	21.70	22.00
Plates Chicago	$35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	37.30
Billets (Bess.) Pittsburgh	$27.00	27.50	27.65	27.75	27.00	26.25	27.00	28.00	28.50	28.50	29.00	29.75
Bessemer Pig Pittsburgh	$17.32	17.29	17.26	17.25	17.24	17.38	17.57	17.96	18.44	20.06	21.96	22.75
Beams Pittsburgh	$34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
Bar Iron Cleveland	$38.00	35.50	34.00	33.00	32.00	32.00	32.00	33.50	34.00	36.00	39.00	39.00
No. 2 Foundry Birmingham	$14.00	14.00	13.70	13.65	13.75	13.50	13.00	14.15	16.00	17.15	21.25	22.00

1905

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$17.50	17.50	17.50	17.50	17.25	16.60	16.15	16.35	16.50	17.55	18.90	19.50
Gray Forge Cincinnati	$15.25	15.20	15.00	15.20	14.81	13.35	12.28	13.00	13.00	13.88	15.35	15.75
Plates Chicago	$31.30	32.30	32.30	34.80	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30
Billets (Bess.) Pittsburgh	$21.00	24.90	24.60	25.50	23.50	22.00	22.00	23.50	25.77	25.95	26.30	26.50
Bessemer Pig Pittsburgh	$16.85	16.45	16.35	16.30	16.20	15.65	15.00	15.40	15.90	16.50	17.70	18.10
Beams Pittsburgh	$30.00	31.00	32.00	32.00	32.00	32.00	32.00	32.00	34.00	34.00	34.00	34.00
Bar Iron Cleveland	$33.25	33.00	32.00	32.00	31.50	30.00	29.75	32.00	34.00	34.25	37.20	40.00
No. 2 Foundry Birmingham	$13.50	13.50	13.50	13.25	12.75	11.85	11.00	11.65	11.75	12.50	14.00	14.00

Charts based on above prices are published as a supplement of today's issue.

A Hotel of Distinction

PATRONIZED by distinguished people of every walk in life and from every part of the world, The Hollenden is noted everywhere for the distinctive atmosphere of refinement and faultless service that permeates every department.

Centrally situated in the heart of the leading business, banking, theatrical and shopping districts of Cleveland; the most easily accessible first-class hotel from all lake and railway terminals, The Hollenden affords the utmost convenience to tourists, travelers and others seeking metropolitan service and location.

The excellence of the cuisine in The Hollenden's series of three nationally-known restaurants, numerous private dining rooms and great Banquet Hall and Ball Room, the largest between New York and Chicago, never varies.

800 comfortable, modern rooms; the only individual floor service in Ohio and the capacity to seat two thousand diners on the same floor simultaneously, complete but do not exhaust the unchallenged features that distinguish The Hollenden.

EUROPEAN PLAN, WITH BATH:

For One Person—
$2.00, $2.50, $3.00, $3.50, $4.00 and $5.00

For Two Persons—
$3.00, $3.50, $4.00, $5.00 and $6.00

With Twin Beds - - $4.00, $5.00 and $6.00

Suites at various Prices

The Hollenden
Cleveland

The New Ball Room

IRON AND STEEL PRICES

Corrected up to Tuesday noon

PIG IRON

Bessemer valley	$35.00
Bessemer, Pittsburgh	35.95
Basic, Pittsburgh	30.95
Basic, eastern Pa.	30.50 to 31.00
Basic, Buffalo	35.00
Malleable, Pittsburgh	31.95 to 33.95
Malleable foundry, Chicago	30.00 to 31.00
Malleable foundry, Philadelphia	32.00 to 33.00
Malleable foundry, Buffalo	35.00
No. 1X foundry, Philadelphia	30.50 to 31.50
No. 2 foundry, Pittsburgh	31.95 to 33.95
No. 2 foundry, Cleveland	30.30 to 31.30
No. 2 foundry, Ironton	30.00
No. 2 foundry, Chicago	30.00 to 31.00
No. 2X foundry, Philadelphia	29.50 to 30.50
No. 2X foundry, N. J. tidewater	29.50 to 30.50
No. 2X foundry, Buffalo	35.00
No. 2 plain, Philadelphia	29.00 to 29.50
No. 2 plain, N. J. tidewater	29.00 to 29.50
No. 2 plain, Buffalo	35.00
No. 2 southern, Birmingham	23.00 to 25.00
No. 2 southern, Cincinnati	26.40 to 27.90
No. 2 southern, Chicago	27.50 to 28.00
No. 2 southern, Phila. delivery	28.00 to 30.00
No. 2 southern, Cleveland	27.50 to 29.00
No. 2 southern, New York docks	28.25 to 30.25
No. 2 southern, Boston docks	28.00 to 30.00
No. 2 south. interior, New Eng.	29.00 to 31.00
No. 2 southern, St. Louis	
Virginia, No. 2X furnace	26.00 to 28.00
Virginia, No. 2X, Philadelphia	28.75 to 30.75
Virginia, No. 2X, Jersey City	29.00 to 31.00
Virginia, 2X, Boston points	29.25 to 31.25
Gray forge, eastern Pa.	28.50 to 29.00
Gray forge, Pittsburgh	30.95
Gray forge, Birmingham	22.00
Silveries, 8 per cent, furnace	36.00 to 37.00
Silveries, 8 per cent, Chicago	38.50
Low phos. Standard, Phila.	52.00 to 55.00
Low phos. Lebanon, Pa., furnace	50.00 to 55.00
Low phos., Pittsburgh	50.00 to 51.00
Charcoal, Lake Superior, Chgo., Nos. 1 to 4	33.75 to 34.75
Charcoal, Buffalo	24.00 to 27.00
Charcoal, Birmingham	26.00 to 27.00

IRON ORE

Lake Superior Ores.
(Lower Lake Ports.)

Old range Bessemer, 55 per cent, ton	5.95
Messabi Bessemer, 55 per cent, ton	5.70
Old range non-Bes., 51½ per cent, ton	5.20
Mesabi non-Bess., 51½ per cent, ton	5.05

Port Henry Ores.
(Per unit delivered eastern Pa.)
(All non-Bessemer.)

Old Bed, crude, 58 per cent	10.50c to 11.00c
Old Bed, concent., 65 per cent.	11.00c to 11.50c
Harmony concent., 63 per cent.	11.50c to 11.75c
Lump (at mines)	$5.75

Foreign Ores.
(Per unit, Philadelphia.)

Foreign Bess., 50 to 65 per cent	nominal
For'n non-Bess., 50 to 65 per cent	nominal

COKE

(At the ovens.)

Connellsville furnace	$11.00 to 12.00
Connellsville furnace, contract	5.00
Connellsville foundry, contract	6.00 to 6.75
Connellsville foundry	11.50 to 12.00
Wise county furnace, contract	4.50 to 5.00
Wise county foundry, contract	5.00 to 7.00
Pocahontas foundry, contract	5.00 to 7.00
Pocahontas furnace, contract	4.50 to 5.00
New River foundry, contract	5.25 to 7.50
New River furnace, contract	5.00 to 5.50

FERRO ALLOYS AND STEEL MAKING METALS

Ferro manganese, 80 per cent, seaboard, or delivered prompt	$164 to 175
Ferro manganese, 80 per cent, seaboard, or delivered, contract	164 to 175
Spiegel, 20 per cent, fur. early and last half	50.00 to 55.00
Ferro-silicon, 60 per cent, Pbg.	95.00 to 100.00

Bessemer ferro-silicon, 9 per cent to 10 per cent, $4100; 10 to 11 per cent, $42.00; 11 to 12 per cent, $43.00; 12 to 13 per cent, $44.00 a ton at the furnace at Ashland, Jackson and New Straitsville, O.

Ferro-carbon titanium, 8 to 12½ cents per pound in carloads.

SEMI-FINISHED MATERIAL

Open hearth billets, Phila.	$55.00 to 60.00
Forging billets, Phila.	75.00 to 85.00
Forging billets, Pbgh., nominal	75.00 to 85.00
Forging billets, Chicago	70.00
Wire rods, Pittsburgh	70.00 to 75.00
Bessemer billets, Youngstown	60.00 to 65.00
Bessemer billets, Pittsburgh	60.00 to 65.00
Open hearth billets, Pittsburgh	60.00 to 65.00
Open hearth billets, Youngstown	60.00 to 65.00
Bess. sheet bars, Youngstown	60.00 to 65.00
Op. h'th sheet bars, Youngstown	60.00 to 65.00
Bess. sheet bars, Pittsburgh	60.00 to 65.00
Open hearth sheet bars, Pbgh.	60.00 to 65.00
Muck bars, Pittsburgh (nominal)	50.00

SKELP

Grooved steel skelp	3.00c
Sheared steel skelp	3.50c

RAILS AND TRACK MATERIAL

(Gross tons.)

Stand. Bess. rails, Pbgh. & Chgo.	$38.00
Stan. op-h'th rails, Pbgh. & Chgo.	40.00
Light rails, 8 to 10 lbs., Pbgh.	53.00
Light rails, 8 lb., Chicago	49.00
Light rails, 12 to 14 lbs., Pbgh.	52.00
Light rails, 12 lbs., Chicago	47.00
Light rails, 16 to 20 lbs., Pbgh.	51.00

Freight Rates, Pig Iron

Mahoning and Shenango valleys to:—	
Cleveland	$0.95
Newark, N. J.	2.98
Boston	3.18
Philadelphia	2.78
Pittsburgh	.95
St. Louis	3.18
Buffalo to:—	
Albany, N. Y.	$1.26
New England (all rail)	2.58
New York and Brooklyn (all rail)	2.58
New York ad Brooklyn (by canal)	1.25 to 1.60
Virginia furnaces to:—	
Boston docks (r. and w.)	$3.05
New England (all rail)	3.25
New York dock (r. and w.)	2.88
Birmingham, Ala., to:—	
Cincinnati	$2.90
Chicago	4.00
Cleveland	4.00
Louisville, Ky.	2.65
New York (all rail)	6.15
New York (r. and w.)	4.25
Philadelphia (all rail)	5.20
Philadelphia (r. and w.)	4.00
Pittsburgh	4.90
Savannah, Ga.	2.75
Chicago to:—	
Des Moines	$2.80
Milwaukee	.50
Moline, Ill.	1.40
Omaha	3.58
St. Louis	1.58
Ironton and Jackson, O., to:—	
Chicago	$2.54
Cincinnati	1.26
Cleveland	1.62
Detroit	1.81
Indianapolis	1.58

Light rails, 16 to 20 lbs., Chgo.	$46.00
Light rails, 25 to 45 lbs., Pbgh.	50.00
Light rails, 25 to 45 lbs., Chgo.	45.00
Relaying rails, standard, Pbgh. and Chicago	$33.00 to 34.00
Relaying rails light, Chicago	34.00 to 35.00
Angle bars, st. sect., Pbgh. base	2.50c to 2.75c
Angle bars, st. sections, Chgo.	2.25c to 2.75c
Spikes, railroad, Pittsburgh	3.40c
Spikes, railroad, Chicago	3.50c
Track bolts, Pittsburgh	4.50c to 4.75c
Track bolts, Chicago	4.25c to 4.50c
Tie plates, Chicago	$55.00 to 60.00

SHAPES, PLATES AND BARS

Structural shapes, con. Pbgh.	3.00c
Structural shapes, Pbgh.	3.00c to 3.25c
Structural shapes, Philadelphia	3.159c to 3.659c
Structural shapes, Chicago	3.19c to 3.75c
Structural shapes, New York	3.169c to 3.669c
Tank plates, Chicago	3.79c to 4.25c
Tank plates, Pittsburgh (con.)	3.50c to 4.50c
Tank plates, Pittsburgh	4.50c to 5.00c
Tank plates, Philadelphia	3.909c to 4.659c
Tank plates, New York	3.919c to 4.669c
Bars, soft steel, Chicago	3.09c to 3.50c
Bars, soft steel, Pbgh (con.)	2.90c
Bars, soft steel, Pittsburgh	3.00c to 3.25c
Bars, soft steel, New York	3.169c to 3.419c
Bars, soft steel, Philadelphia	3.159c to 3.409c
Hoops, carloads, Pbgh. contr.	3.50c
Hoops, Pbgh.	4.00c to 4.25c
Bands, Pittsburgh	3.90c to 4.10c
Bands, Pittsburgh (contr.)	3.00c
Shafting, Pbgh., contr. carloads	10 to 20 off
Bar iron, Chicago	3.00c
Bar iron, Philadelphia	3.159c
Bar iron, Cleveland	3.00c
Bar iron, New York	3.159c
Bar iron, Pittsburgh	3.25c
Hard steel bars, Chicago	3.00c

SHEETS

(In cents per pound).
(Open hearth material takes 10c above prices of bessemer.)

SHEET MILL BLACK.

Gage.	Bessemer.
17 to 21	4.55 to 5.30
22 to 24	4.60 to 5.25
25 and 26	4.65 to 5.40
27	4.70 to 5.45
28	4.75 to 5.50
29	4.80 to 5.55
30	4.80 to 5.65

TIN MILL BLACK.

Gage.	Bessemer.
15 and 16	4.55 to 5.05
17 to 21	4.60 to 5.10
22 to 24	4.65 to 5.15
25 to 27	4.70 to 5.20
28	4.65 to 5.25
29 and 30	4.80 to 5.30
30½ and 31	4.85 to 5.35

GALVANIZED.

Gage.	Bessemer.
10 and 11	5.75 to 6.50
12 to 24	5.85 to 6.60
15 and 16	6.00 to 6.75
17 to 21	6.15 to 6.95
22 to 24	6.20 to 6.95
25 and 26	6.45 to 7.20
27	6.60 to 7.35
28	6.75 to 7.50
29	6.95 to 7.70
30	7.15 to 7.95

BLUE ANNEALED.

Gage.	Bessemer.
3 to 8	4.00 to 4.75
9 to 10	4.00 to 4.75
11 to 12	4.00 to 4.75
13 and 14	4.00 to 4.75
15 and 16	4.00 to 4.75

No. 28 black, Chicago	4.69c
No. 28 galvanized, Chicago	5.19c
No. 10 blue annealed, Phila.	4.159c to 4.659c
No. 10 blue annealed, Chicago	4.69c

TIN PLATE

Tin plate, 100 lb., coke base	6.50c to 7.00c
Terne plate	5.75c

IRON AND STEEL PIPE

(Prices adopted Dec. 4, 1916.)

Steel.

Butt weld:—	Black.	Galv.
⅛, ¼ and ⅜ in.	57	30½
½ in.	63	46½
¾ to 3 in.	64	50½
Lap weld:—		
2 in.	57	44½
2½ to 6 in.	60	47½
7 to 12 in.	57	43½
13 and 14 in.	47½	....
15 in.	45	....

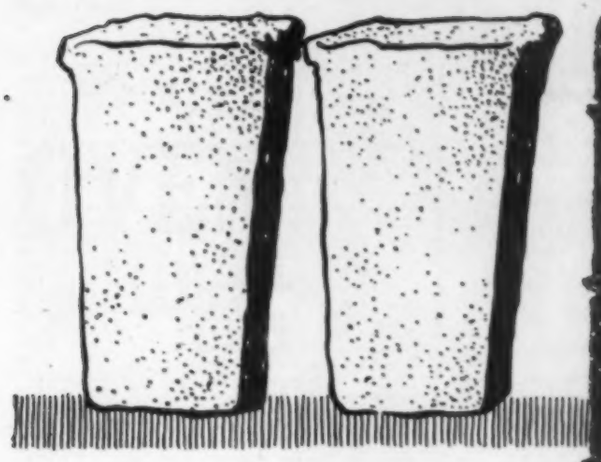
Iron.

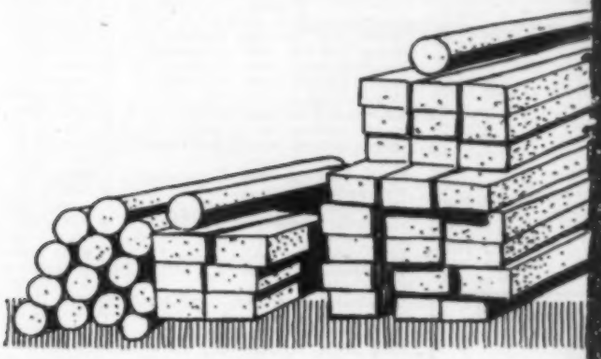
Butt weld:—	Black.	Galv.
⅛ and ¼ in.	42	14
⅜ in.	43	15
½ in.	47	28
¾ to 1½ in.	50	33
Lap weld:—		
1¼ in.	36	20
1½ in.	42	27
2 in.	43	28
2½ to 6 in.	45	31
7 to 12 in.	44	30

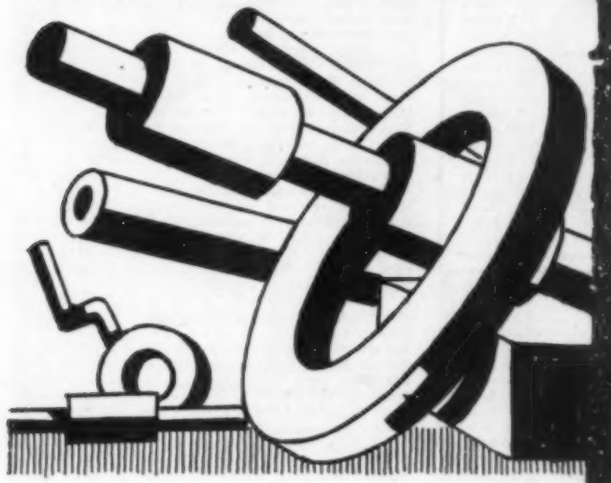
BOILER TUBES

Steel, 3¼ to 4½ inches l. c. l.	46
Iron, 3½ to 4½ inches l. c. l.	36

FORGINGS







Our Exceptional Facilities
enable us to give you

COMPLETE SERVICE

Ingots
Special Analysis--Emergency Needs
cast from our

Induction Electric Furnace

—

Large
Hydraulic Press—Steam Hammer
Capacity

—

Hollow Boring—Rough Machining

—

Unusual Equipment for
Scientific Heat Treating and Testing

—

Let us hear from you

The Crucible Steel Forge Co.
Grant Ave., S. E., near E. 71st St.
CLEVELAND

H. V. HARTER
827 Grant Boulevard
MILWAUKEE
District Representative

IRON AND STEEL PRICES

Corrected up to Tuesday noon

WIRE PRODUCTS

(Adopted Nov. 24, 1916.)
(Retailers' price 5 cents above jobbers' quotations.)

Wire nails, jobbers', Pittsburgh	$3.00
Plain wire, jobbers', Pittsburgh	2.95
Galvanized wire, jobbers', Pbgh	3.65
Polished staples, Pbgh	3.15
Galvanized staples, Pbgh	3.85
Bard wire, painted, jobbers', Pbgh.	3.15
Barb wire, galv., jobbers,' Pbgh	3.85

BOLTS AND NUTS

(Delivered within 20-cent freight radius.)

Carriage bolts, ⅜ x 6 inches, smaller or shorter, rolled thread, 40 and 10; cut threads, 40 and 2½, larger or longer, 30 and 5.

Machine bolts with hot pressed nuts ⅜ x 4 inches, smaller or shorter rolled 50; cut, 40 and 10; larger or longer, 35 and 5.

Cold pressed, semi-finished hexagon nuts, 50, 10 and 5.

Gimlet and cone point lag bolts, 50. Hot pressed square nuts, blanks, $2.50 off; tapped $2.30 off. Hot pressed hexagon nuts, blank, $2.50 off; tapped, $2.30 off.

Cold pressed square nuts, blank, $2.10 off; tapped, $1.90 off. Cold pressed hexagon nut, blank, $2.25 off; tapped, $2.00 off.

RIVETS

Structural rivets, Pbgh	4.25c
Boiler rivets, Pbgh	4.35c

Tinner's rivets, 40 and 10 off, Pittsburgh.

STEEL SHEET PILING

(Pittsburgh.)

Base sizes	3.00c

STANDARD STEEL CHAIN

Chain, ⅜ inch proof coil	6.00c

COLD ROLLED STRIP STEEL

Base price, 7.00c per 100 pounds, hard, coils 1½ inches and wider and by .100 inch and heavier.

CAST IRON WATER PIPE

Four-inch, Chicago	$44.00 to 45.00
Six-inch and larger, Chicago	41.00 to 42.00
Six-inch Class B, New York	41.50
Four-inch Class B, New York	44.50
Four to six-inch Birmingham	39.00
Six-inch and larger, Birmingham	36.00

Light weight water and gas pipe $1 per ton higher than standard water.

WAREHOUSE PRICES

Steel bars, Chicago	3.60c
Steel squares, 2-in. & ov., Cleve.	4.25c
Steel rounds, 2-in & ov., Cleve.	4.25c
Steel bars, und. 2 in., Cleveland	3.75c
Steel bars, Detroit	3.60c
Steel bars, Philadelphia	3.75c
Steel bars, New York	3.85c
Steel bars, St. Louis	3.65c
Steel bars, Cincinnati	3.70c to 4.25c
Steel bars, St. Paul	3.70c
Steel bars, over 2-in., Buffalo	4.40c
Steel bars, Buffalo	3.75c
Iron bars, Chicago	3.60c
Iron bars, Cleveland	3.70c
Iron bars, Detroit	3.60c
Iron bars, St. Louis	3.60c
Iron bars, Cincinnati	3.70c to 4.25c
Iron bars, Philadelphia	3.50c
Iron bars, New York	3.75c
Shapes, Chicago	3.70c
Shapes, Detroit	3.70c
Shapes, St. Louis	3.75c
Shapes, St. Paul	3.80c
Shapes, New York	3.95c
Shapes, Cleveland	3.85c
Shapes, Philadelphia	3.75c
Shapes, Buffalo	3.85c
Shapes and plates, Cincinnati	3.80c to 4.35c
Plates, Chicago	4.35c
Plates, Detroit	4.35c
Plates, St. Louis	4.40c
Plates, St. Paul	4.45c
Plates, New York, wide	5.00c
Plates, New York, narrow	4.75c
Plates, Cleveland	4.35c
Plates, Philadelphia	4.50c to 5.00c
No. 10 blue anl. sheets, Chicago	4.50c
No. 10 blue anl. sheets, Cleve	4.50c
No. 10 blue anl. sheets, Cleveland	4.25c to 4.50c
No. 10 blue anl. sheets, Buffalo	3.25c
No. 10 blue anl. sheets, St. L	4.55c
No. 10 blue anl. sheets, Cincinnati	4.40c
No. 10 blue anl. sheets, St. Paul	4.60c
No. 10 blue anl. sheets, Detroit	4.25c
No. 28 black sheets, Chicago	5.00c
No. 28 black sheets, Cleveland	5.00c
No. 28 black sheets, Cincinnati	4.40c
No. 28 black sheets, Detroit	4.75c
No. 28 black sheets, St. Louis	5.20c
No. 28 black sheets, St. Paul	5.10c
No. 28 galv. sheets, Chicago	7.00c
No. 28 galv. sheets, Cleveland	7.00c
No. 28 galv. sheets, Cincinnati	6.00c
No. 28 galv. sheets, Detroit	7.00c
No. 28 galv. sheets, St. Louis	7.10c
Hoops, Cleveland	4.50c
Hoops, Detroit	4.25c

Coke Oven By-Products

Spot.

Per Gallon at Producers Plant.

Pure benzol	$0.55 to .60
Toluol	2.50
Solvent naphtha	.25

Per Pound at Producers Plant.

Phenol	$0.50 to .55

Per 100 Pounds at Seaboard.

Sulphate of ammonia	$4.00 to 4.05

Contract.

Per Gallon at Producers Plant.

Pure benzol	$0.55
Toluol	1.50 to 1.75
Solvent naphtha	.25

Per Pound at Producers Plant.

Phenol (nominal)	$0.55

Per 100 Pounds at Seaboard.

Sulphate of ammonia (nearby)	$4.00 to 4.05

IRON AND STEEL SCRAP

(Net Tons.)

Angle bars, iron, Chicago	$27.50 to 28.00
Angle bars, steel, St. Louis	20.00 to 20.50
Arch bars and transoms, St. L	27.00 to 27.50
Arch bars and transoms, Chgo	29.00 to 29.50
Cast, No. 1, St. Louis	19.50 to 18.00
Boiler plate, cut, No. 1, Chgo	15.00 to 15.50
Boiler plate, cut, No. 1, St. L	14.00 to 14.50
Boiler punchings, Chicago	21.00 to 22.00
Bundled sheet, Cincinnati	12.50 to 13.00
Busheling, No. 1, Chicago	17.50 to 18.00
Busheling, No. 1, Cincinnati	16.50 to 17.00
Busheling, No. 1, Cleveland	18.00 to 18.50
Busheling, No. 1, St. Louis	16.00 to 16.50
Busheling, No. 2, Chicago	12.50 to 13.50
Cast borings, Chicago	8.50 to 9.00
Cast borings, Cincinnati	8.50 to 9.00
Cast borings, Cleveland	9.25 to 9.50
Cast borings, St. Louis	8.00 to 8.50
Cast, No. 1, Chicago	15.50 to 16.00
Cast, No. 1, Cincinnati	15.50 to 16.00
Cast, No. 1, Cleveland	18.00 to 18.50
Cast, No. 1, St. Louis	16.00 to 16.50

Freight Rates, Finished Material

From Pittsburgh, carloads, per 100 lbs. to:—

New York	16.9 cents
Philadelphia	15.9 cents
Boston	18.9 cents
Buffalo	11.6 cents
Baltimore	15.4 cents
Cleveland	10.5 cents
Cincinnati	15.8 cents
Chicago	18.9 cents
Detroit	15.7 cents
Minneapolis and St. Paul	32.9 cents
Denver	83.6 cents
St. Louis	23.6 cents
New Orleans	30 cents
Birmingham	45 cents
Pacific coast (all rail)	73.9 cents
Pacific coast (tin plate)	70 cents
Pacific coast, via Panama canal	61.9 cents

Cut forge, Chicago	22.00 to 22.50
Grate bars, Cleveland	12.00 to 12.50
Iron axles, St. Louis	33.50 to 34.00
Iron axles, Cleveland	45.00 to 46.00
Knuckles, coup., Chicago	25.00 to 26.00
Knuckles, coup., St. Louis	24.00 to 24.50
Locomotive tires, Chicago	29.00 to 29.50
Locomotive tires, St. Louis	27.00 to 27.50
Machine shop turnings, Chicago	10.25 to 10.75
Machine shop turnings, Cleveland	10.50 to 11.00
Machine shop turn'gs, Cincinnati	8.00 to 8.50
Machine shop turnings, St. Louis	8.00 to 8.50
Malleable agricultural, Chicago	15.50 to 16.00
Malleable agricultural, St. Louis	15.00 to 15.50
Malleable, Cincinnati	13.00 to 13.50
Malleable railroad, Chicago	18.00 to 18.50
Malleable railroad, St. Louis	16.00 to 16.50
Pipes and flues, Cleveland	15.00 to 15.75
Pipes and flues, Chicago	15.00 to 15.50
Pipes and flues, St. Louis	15.00 to 15.50
Railroad wrought, No. 1, Cleve	25.00 to 25.50
Railroad wrought, No. 1, Chgo	24.50 to 25.00
Railroad wrought, No. 1, Cinci	21.50 to 22.50
Railroad wrought, No. 1, St. L	23.50 to 24.00
Railroad wrought, No. 2, Chgo	22.00 to 22.50
Railroad wrought, No. 2, St. L	22.50 to 23.00
Shafting, St. Louis	25.00 to 25.50
Springs, Chicago	26.00 to 26.50
Steel car axles, St. Louis	35.00 to 35.50
Steel car axles, Chicago	41.00 to 42.00
Stove plate, Chicago	12.50 to 13.00
Stove plate, Cleveland	12.25 to 12.75
Stove plate, Cincinnati	11.50 to 12.00
Stove plate, St. Louis	13.00 to 13.50

(Gross Tons.)

Axle turnings, Cleveland	$16.50 to 16.75
Axle turnings, Buffalo	17.50 to 18.00
Busheling, No. 1, Buffalo	21.50 to 22.00
Busheling, No. 1, Pittsburgh	18.50 to 19.00
Busheling, No. 2, Buffalo	15.00 to 15.50
Bundled sheets, Pittsburgh	16.00 to 16.50
Bundled sheets, Cleveland	14.50 to 15.00
Bundled sheets, Buffalo	15.00 to 16.00
Bundled tin, Buffalo	15.00 to 16.00
Car wheels, (iron), Pittsburgh	23.00 to 24.00
Car wheels, (steel), Pittsburgh	29.00 to 30.00
Car wheels, Chicago	20.00 to 20.50
Car wheels, eastern Pa	22.50 to 23.50
Car wheels, Buffalo	23.00 to 24.00
Car wheels, New York	21.00 to 21.50
Car wheels, St. Louis	22.50 to 23.00
Car wheels, Birmingham	19.00 to 20.00
Car wheels, Cleveland	19.00 to 19.50
Tram car wheels, Birmingham	17.00 to 18.00
Cast borings, New York	11.50 to 12.00
Cast borings, eastern Pa	14.00 to 15.00
Cast borings, Buffalo	11.50 to 12.00
Cast borings, Pittsburgh	12.25 to 12.50
Cast, No. 1, eastern Pa	21.50 to 22.50
Cast, No. 1, Pittsburgh	20.00
Cast, No. 1, Birmingham	19.00 to 20.00
Cast, heavy, No. 1, N. J. points	20.50 to 21.00
Forge, No. 1, eastern Pa	16.50 to 17.50
Frogs, switches, guards, St. L	22.00 to 22.50
Grate bars, Buffalo	15.50 to 16.00
Grate bars, N. J. points	15.00 to 15.50
Heavy axle turnings, Buffalo	15.00 to 15.50
Heavy melting steel, Pittsburgh	25.00 to 27.00
Heavy melting steel, Buffalo	26.00 to 27.00
Heavy melting steel, Chicago	22.50 to 23.00
Heavy melting steel, Cleveland	22.00 to 22.50
Heavy melting steel, Cincinnati	20.00 to 21.00
Heavy melting steel, eastern Pa	23.00 to 24.00
Heavy melting steel, New York	22.50 to 22.75
Heavy melting steel, St. L	22.50 to 23.00
Heavy melting steel, Birmingham	21.00 to 22.00
Hydraulic pressed sheet, Cleveland	17.50 to 18.00
Hydraulic pressed sheets, Pbgh	22.00 to 23.00
Hydraulic pressed sheets, Chgo	18.25 to 19.25
Iron rails, Chicago	29.00 to 29.50
Iron rails, Buffalo	25.00 to 26.00
Iron rails, Cincinnati	24.50 to 25.00
Iron rails, St. Louis	25.00 to 25.50
Iron rails, Cleveland	29.00 to 29.50
Iron axles, Pittsburgh	39.00 to 40.00
Iron axles, Cincinnati	40.50 to 41.00
Iron axles, eastern Pa	38.00 to 40.00
Iron axles, Chicago	42.50 to 43.50
Iron axles, Buffalo	45.00
Low phos. steel, Buffalo	32.00 to 34.00
Low phos. steel, Pittsburgh	34.00 to 36.00
Low phos. steel, eastern Pa	32.00 to 34.00
Machine shop turnings, Buffalo	11.50 to 12.00
Mch. shop turnings, New York	11.25 to 11.50
Mch. shop turnings, Pittsburgh	12.25 to 12.50
Mch. shop turnings, eastern Pa	13.00 to 14.00
Mch. shop turnings, Birmingham	10.00 to 11.00
Malleable railroad, Cleveland	20.50 to 21.00
Malleable railroad, Buffalo	23.00 to 24.00
Malleable railroad, Pittsburgh	21.00 to 21.50
Malleable railroad, eastern Pa	18.00 to 19.00
R. R. and mch. cast, No. 1, Bfl.	23.00 to 24.00
R. R. wrought, No. 1, Buffalo	30.00 to 31.00
R. R. wrgt., No. 1, eastern Pa	27.00 to 28.00
City wrought, New York	21.50 to 22.00
R. R. wrought, No. 1, Pbgh	23.00
R. R. wrought, No. 1, B'ham	21.00 to 22.00
Reroll. rails, 5 ft. & ov., Pbgh	26.00
Reroll. rails, 5 ft. & ov., Chgo	28.00 to 29.00
Reroll. rails, 5 ft. & ov., E. Pa	27.00 to 28.00
Reroll. rails, 5 ft. & ov., St. L	26.00 to 27.00
Shafting, New York	25.50 to 26.50
Shafting eastern Pa	31.00 to 32.00
Shoveling steel, Chgo	20.00 to 20.50
Shoveling steel, St. Louis	17.50 to 18.00
Steel rails, short, Chicago	25.00 to 25.50
Steel rails, short, Cleveland	27.00 to 28.00
Steel rails, over 6 ft., Cleveland	21.00 to 22.00
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Steel car axles, Buffalo	45.00
Steel car axles, Cleveland	49.00 to 50.00
Steel car axles, Pittsburgh	39.00 to 40.00
Steel car axles, eastern Pa	38.00 to 40.00
Stove plate, N. J. points	15.00 to 15.50
Stove plate, Birmingham	12.50 to 13.50
Stove plate, Buffalo	16.00 to 16.50
Stove plate, eastern Pa	17.00 to 18.00
Stove plate, Pittsburgh	14.00 to 14.50
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The success of our efforts is reflected in the class of customers we serve.

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Write for our Pocket Catalog of Young Ovens.

You can judge ***"Young Ovens"*** by the company they keep.

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ALLOYS (Boron—Copper—Nickel—Shot).
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